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The Rôle of Vitamins in Animal Nutrition
A Brief Survey*

N. J. SCORGIE, M.A., B.Sc., M.R.C.V.S.,
Royal Veterinary College, London.

The early work leading to the discovery of the vitamins is now so well known that I do not propose to refer to it in this paper. The most authoritative information of the work up to 1932 will be found in the report published by the Medical Research Council, 1932.[1]

According to our present knowledge, there are at least seven vitamins for whose existence the evidence is sufficiently definite and complete. The generally accepted vitamins are designated—A; B complex including B_1 (anti-neuritic factor) and B_2 or G (growth factor); C; D; E; and K.

Although it is customary to consider the vitamins as a group of substances having similar properties, it should be clearly understood that the vitamins are chemically unrelated and that the group name has no chemical significance. All have a highly complex chemical structure and it is not surprising that knowledge of their chemical nature has lagged far behind their discovery. Remarkable progress has, however, been made in this direction during the last ten years and it is now possible to prepare the following vitamins synthetically: *viz.*, B_1 (aneurin), two factors of the B complex—nicotinic acid and lactoflavine—and C and D.

Vitamins in Relation to Animal Feeding

The vitamin requirements of the domestic animals are as yet imperfectly understood. Most of the knowledge of vitamins has been derived from experiments with laboratory animals. Amongst these, the requirements have been found to vary widely from species to species. Thus, it has been shown that rats are especially liable to suffer from deprivation of vitamin A, whilst guinea-pigs are far less susceptible. The requirements of poultry are stated to be even higher than those of the rat. Again, some species appear to be almost independent of a supply of certain vitamins in the diet. For example, the requirements of rats for vitamin C in the diet are relatively low compared with those of guinea-pigs, and there is evidence which suggests that the rat is able to synthesise vitamin C in its own body.[2] Amongst the domesticated animals, it seems quite well established that vitamin B can be synthesised by bacterial action in the rumen of cattle,[3] and probably in the large colon and caecum of the horse, and that these species, therefore, are independent of the B complex in the food. Poultry have high vitamin B requirements and its absence from the diet of this species gives rise to well-recognised disease symptoms, *e.g.*, polyneuritis due to deficiency of B_1.

Vitamins A and D are necessary for all classes of stock and are of the greatest importance in animal feeding. Under certain conditions, as we shall see later, these two vitamins may be partially or entirely absent from the diet. There is normally no lack of any of the other vitamins in the natural rations fed to domesticated animals, with the exception of vitamin G for poultry and possibly another factor of the vitamin B complex for dogs (P—P factor).

Diseased conditions have now been reported in almost all the domestic animals as a result of an insufficient vitamin A or vitamin D intake. The two species most likely to suffer, particularly from vitamin A deficiency, are pigs and poultry, owing to the fact that the systems of feeding practised in swine and poultry husbandry tend to proceed on more artificial lines than with other classes of stock. In fact, it may be said that the nearer animals are kept to laboratory conditions, the more likely are they to suffer from vitamin deficiencies. Under natural conditions of feeding in this country and where animals receive a properly balanced ration of home-grown foodstuffs, it is unlikely that farm animals will suffer from any obvious and widespread effects of vitamin deficiency. Avitaminosis in cattle, especially deficiency in

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vitamin A, is most likely to occur on a large scale in parts of the world having a wet and dry season and where animals have to subsist on dry forage of inferior quality for prolonged periods. Nevertheless, the possibility of a sub-optimal vitamin intake amongst animals, particularly young growing animals, during the winter months in this country should not be overlooked.

In dealing with the question of vitamin deficiencies in animal feeding, the possibility that vitamins other than those so far identified may be involved should not be ignored. As Fraser[4] in a recent review of this subject has stated: "There may be substances in pasture or soil of as specific value for herbivora as is vitamin C for guinea-pigs and man. It would indeed be surprising if the food requirements of herbivora, swine and poultry were identical with those of rats and guinea-pigs, when the vitamin requirements of these two rodent species themselves differ in so fundamental a way. One may speculate that there may even be food factors essential to certain farm animals and also to man which nutritional studies on rodents will never reveal. It seems unfortunate that the basis of human (and, we may add, animal) nutritional studies should be confined to experiments on a few types of conventional laboratory animals."

Distribution of Vitamins in Animal Foodstuffs

In considering the distribution of vitamins in animal feeding stuffs (see Table I.) it will be seen that no single food is rich in all the vitamins. Also, the amount of a particular vitamin present in a food may vary widely, depending on the quality of the foodstuff, whether processed by manufacturing treatment or not, on its stage of growth and, in the case of hay or other dry forage, on how it has been cured.

In this connection, a consideration of the modern trend in stock feeding is of some importance. The departure from a traditional system of agriculture where the bulk of an animal's food consisted of grass and home-grown cereals may in some measure be responsible for the long list of disease conditions which have increased in incidence or severity in the last 25-30 years. Standard rations are the order of the day, and the productive part of such rations generally consists of foreign cereals and oil cakes, which in many cases are the by-product of some other industry. Thus Maynard[5] in his admirable book on "Animal Nutrition" comments: "Modern milling practices separate the whole seeds formerly fed into many fractions having different feed values. Various industries are taking more and more of certain products for human food and other uses. This has resulted in a modification of the nature of the by-products available for animals and, frequently, in a lowering of the nutritive value of such products." It is the practice of the modern stock feeder to buy his concentrates direct from merchants instead of growing them at home. It was at one time a common custom for the farmer to have his own oats and barley freshly milled at the nearby mill and the products brought back for the feeding of his own animals. Some of the vitamins are extremely sensitive to oxidative and fermentative processes, and it was just the freshness of these home-milled foodstuffs which guaranteed an adequate supply of these food factors in the diet of the animals.

Vitamin A.

According to our present knowledge, vitamin A does not occur as such in the plant kingdom. Its precursors, the various forms of carotene and related pigments, are, however, present in large amounts in all the green parts of growing plants. The conversion of carotene into the vitamin takes place in the animal body, especially in the liver. One of the richest sources of carotene for farm animals is young actively growing grass, and livestock on good pasture always have an abundant supply of the vitamin. A considerable part of the carotene is destroyed in the making of hay since both carotene and vitamin A are readily destroyed by oxidation. Exposure to bright sunlight accelerates oxidation, so that there is always considerable destruction of carotene in the curing of hay, even under the best conditions. For example, Russel[6] reports that the loss of carotene in lucerne may be as high as 80 per cent. during the first 24 hours of the curing process. In spite of this, well-cured hay of good quality is still a good source of carotene for indoor animal feeding. When, however, the hay has been badly bleached by undue exposure to bright sunlight or exposed to prolonged rain whilst lying in the swathe, the losses in carotene are serious, and samples of such hay have practically no vitamin A value. In general, the carotene content of hay is roughly parallel to its chlorophyll content, so that good green-coloured hay is always fairly rich in carotene, whilst brown or straw-coloured hays are very poor sources. Further carotene loss takes place in the fermentation processes which occur when the hay is stacked, but if the hay has been secured under favourable conditions and there is no undue heating, this loss will be relatively small. It should be remembered, however, that since carotene deteriorates with keeping, one-year-old hay has little vitamin A value left, and older hays practically none.

The conservation of grass by artificial methods ("dried grass") is superior to natural

sun drying in that there is little loss of carotene owing to the speed with which the drying process is carried out.[7]

With the exception of yellow maize, the grains of the common cereals are practically devoid of vitamin A value.

Carrots are good sources of the vitamin A precursor, but turnips, swedes, mangolds and potatoes probably supply no appreciable amounts.

Milk and other dairy products containing butter fat generally contain a quantity of vitamin A. This is highest when the cows receive fresh green food and lowest when the diet consists of cereals and roots.[8] Skim milk has little vitamin present, most of it being removed in the butter fat. Hence the necessity for adding supplements of the vitamin in the form of cod liver oil in the rearing of calves on skim milk or other milk substitutes.

In regard to other animal products used for feeding, muscle tissues are poor in vitamin A, whilst liver, animal fats and eggs are usually much richer sources. Cod liver oil and halibut oil are probably the richest sources available. Fish meal may contain vitamin A but the amount is too variable for this substance to be regarded as a source of supply for livestock feeding purposes.

In many compound proprietary meals, cakes and cubes, cod liver oil is added as a supplement to provide vitamins A and D, but it is doubtful whether such mixtures have any vitamin A value owing to the destruction of the vitamin which results from oxidative processes which take place in the mixing of the meals or in the pressing of the cakes and cubes. The vitamin A value is also likely to be further lowered if these feeding stuffs have been prepared and stored for a long time.

Vitamin B Complex.

It is thought that at least six or seven factors comprise the vitamin B complex.[9]

B_1 (aneurin)—the anti-neuritic vitamin.

B_2 — Lactoflavine—a flavine compound promoting growth in the rat.

B_2 — P—P factor — deficiency of this factor produces pellagra in humans. Nicotinic acid, absence of which results in black-tongue in dogs, may be one fraction of this factor.

B_2 — B_6—absence of this factor from diet of the rat results in dermatitis.

B_3 —a factor essential to the maintenance of weight in pigeons and chickens.

B_4 —absence of this factor from the diet of rats causes muscular weakness and spasticity.

B_5 —a factor similar to B_1 and B_3 but is less thermolabile. It is necessary for maintenance of weight in pigeons.

Brewer's yeast is the richest source of the vitamin B complex. Most unmilled cereal grains also contain large amounts, particularly in the aleurone layer of the husk. It is also synthesised in the rumen of cattle by bacterial action.

In connection with B_2, this vitamin formerly thought to be one single substance has now been split up into at least four compounds—lactoflavine, P—P factor, nicotinic acid, and B_6.

Lactoflavine is apparently needed in very large amounts by the chick for growth,[10] but it is supplied in ample amounts in the rations of other animals. It is present in adequate amount in milk, cereals, grasses and other forage.

Vitamin C. (Ascorbic acid).

Fresh fruits and some vegetables and roots are the principal sources of vitamin C. Animal products such as raw meat, milk or eggs contain only very small amounts. Little is known regarding the requirements of livestock for this vitamin. It is probable that they can synthesise it in the body.[11]

Vitamin D.

Of all the vitamins, vitamin D has the most limited distribution in natural food. Best quality sun-cured hay is a good source of vitamin D for farm animals. Cereals, green vegetables and roots contain no appreciable quantities. Whole fresh milk contains fairly large amounts, but is variable. Animals exposed to sunlight can manufacture this vitamin from ergosterol in their bodies. Halibut and cod liver oils are the richest national sources known, but it can be prepared in even more concentrated form by the irradication of ergosterol.

There is now an accumulation of evidence which makes it clear that the anti-rachitic vitamin can no longer be regarded as a single entity. It has been clearly established that there is a multiplicity of vitamins D differing in their chemical properties and in their biological activity toward different species of animal. (For review of the literature on this subject see, Hume, E. M. (1936-37). *Nutrit. Abst. and Rev.* **6**, 891-901). In addition to vitamin D obtained from natural animal sources such as cod liver oils, at least four other forms of vitamin D have been recognised, designated as follows:—

(1) D_2, irradiated ergosterol, or calciferol.
(2) D_3 or irradiated 7- dehydrocholesterol.
(3) Cholesterilene sulphonic acid.
(4) Irradiated heated purified cholesterol,

A practical point which has some bearing on the feeding of the anti-rachitic vitamin to poultry arises in connection with the standardisation of the various forms of vitamin D. Thus, for example, amounts of irradiated ergosterol and cod liver oil which have been found to have equal anti-rachitic potency in rats have different values for the chick, the former being very much less effective. It appears, then, that whilst the rat can utilise both forms of the anti-rachitic factor equally well, the fowl can only utilise efficiently the naturally occurring forms of vitamin D such as are found in the fish liver oils. Statements, therefore, that a particular cod liver oil intended for poultry feeding contains so many rat units or international units of vitamin D are of doubtful value. The practical importance of this fact in poultry feeding is that the addition of vitamin D concentrates, such as calciferol, to the rations or to inferior cod liver oils low in vitamin content is useless as a supply of the anti-rachitic factor.

Vitamin E.

This vitamin is widely distributed in animal foods such as the cereal grains and best quality hay, but it is only present in comparatively small amounts in each. The richest natural source is the wheat germ, in which it is present in great concentration.

Vitamin K. (The anti-haemorrhagic vitamin.)

Is a fat-soluble vitamin occurring in pig liver fat, in hemp seed and in certain vegetables such as tomatoes and kale and to a lesser degree in many cereals.

Absence of vitamin K from the diet of chicks gives rise to a condition which is characterised by large haemorrhages, certain pathological changes in the gizzard, and anaemia. This vitamin is not identical with the fat soluble vitamins A and D, since very large doses of fresh liver oils are ineffective in preventing the disease syndrome. Hog liver fat in the diet will completely suppress the symptoms.[12]

FUNCTIONS OF THE VITAMINS AND THEIR RELATION TO HEALTH

Vitamin A

In the early experiments[13, 14] in connection with the discovery of vitamin A, young growing rats were used. The importance of the vitamin for growth therefore received the most attention for a number of years and as a result it was called "the growth vitamin." Amongst the domesticated animals, it has been shown that in its absence calves[15] and pigs[16] do not maintain normal growth, and that if the condition is left untreated for any length of time characteristic symptoms of deficiency develop.

It has now, however, become clearly recognised that most of the other vitamins are also required for normal growth and that this is not a distinguishing characteristic of vitamin A. A deficiency in the diet or its absence has been shown to be the cause of several characteristic diseased conditions, notably certain pathological changes in the nervous system and in epithelium.

Following on their original observations, Osborne and Mendel[17] showed that shortly after the cessation of growth, experimental rats develop a characteristic disease of the eye known as xerophthalmia. In rats the first symptom observed is a swelling of the eyelids; then there commonly develops an inflamed and catarrhal condition of the conjunctiva with a bloody or purulent discharge, the lids becoming scabby, sticky and stuck together. Ultimately, the cornea becomes involved and blindness results if the condition is left untreated. A similar condition can be produced experimentally in dogs[18], and there are reports in veterinary literature of spontaneous occurrence in this species.[19] We believe that a similar clinical picture which we have observed in young Rex rabbits may be due to a deficiency of vitamin A in the diet of the doe whilst she is pregnant and whilst suckling the young. Further proof is required to incriminate a vitamin A deficiency and we are at present carrying out experiments to determine the truth or otherwise of our supposition.

One of the chief functions of vitamin A is to keep normal epithelium in a healthy condition so that it can resist bacterial infection. Deficiency of the vitamin in the diet "causes the substitution of a stratified keratinizing epithelium for normal epithelium in various parts of the respiratory tract, alimentary tract, paraocular glands, and the genito-urinary tract."[20] The end result of this metaplasia in epithelial tissue is that animals so affected are especially subject to infective diseases of the respiratory and gastro-intestinal tracts. The formation of kidney and bladder stones has also been attributed to this cause, because the damaged epithelium interferes with the normal secretion and elimination of urine.[21]

Deficiency of vitamin A in the diet has also been shown to result in the degeneration of nerve tracts in the brain and spinal cord. These lesions are characterised clinically by inco-ordination of the hind quarters and by severe nervous spasms. In dogs, Mellanby[22] describes the following symptoms: "In addition to inco-ordination, these animals often seemed to be mentally affected; they appeared dazed and were incapable of fixing their attention on anything for more than a moment.

running about from one point to another, sniffing and apparently searching for food, with their ears awry. One of the earlier signs to develop was stiffness, especially of the hind legs, which ultimately became very weak, and the animals preferred to sit or lie about, cramps and convulsions also occasionally developed . . . . These changes could be prevented if butter, egg-yolk or cod liver oil formed part of the diet."

It appears also that vitamin A is necessary for normal reproduction. Thus, Mason[23] has shown that deficiency in the diet of rats causes very rapid degeneration of the epithelium of the testes of the male, and cessation or irregularity of oestrus in the female. When fertilisation does take place, vitamin A deficiency gives rise to alterations in the uterine epithelium and in the placenta which results in death and resorption of the foetus, or in abortion. Similar conditions have been reported in cattle by Guilbert and Hart[24] and in pigs by Hughes, Aubel and Leinhardt.[16]

The reports of Guilbert and Hart[24] in connection with avitaminosis-A occurring naturally amongst range cattle in the United States are of especial interest. When the dry feed season was unusually prolonged—to nine months—various degrees of vitamin A deficiency were observed. The most important manifestations were:—

(1) Expulsion of the foetus prematurely or dead at term. This condition simulates contagious abortion.
(2) Severe diarrhoea in weak new-born calves with simulates white scour.
(3) Ophthalmia in young growing animals.

The condition has also been produced experimentally in cattle by these workers.[25, 26] Night blindness was found to be the first detectable clinical symptom of vitamin A deficiency. This was detected by driving the animals about in enclosures during semi-darkness. Affected animals collided with stationary objects and with other beasts. Several weeks after the onset of night blindness nervous symptoms were manifested. These consisted of inco-ordination of the hind limbs and convulsions. As the condition progressed the animals became totally blind, and on examination in the dark with an ophthalmoscope a characteristic green colour was thrown from the retina which contrasted with the yellowish colour of the retina in normal animals.

Calves born from mothers whose diet is deficient in vitamin A but who may not themselves be showing clinical symptoms are often born blind. Moore, Huffman and Duncan[27] describe an outbreak of this nature where blindness was associated with a constriction of the optic nerve where it passes into the cranial cavity. Blindness in calves most probably associated with vitamin A deficiency has also been reported from India.[28, 29]

As far as I am aware, there are no published records of symptoms amongst cattle in this country attributable to vitamin A deficiency. It is possible, however, that whilst there is no absolute avitaminosis-A there may be a condition of hypovitaminosis—*i.e.*, inadequate vitamin A intake. This might account for outbreaks of abortion not connected with *Br. abortus* infection and for certain cases of white scours and pneumonia in calves. In pigs absence of vitamin A from the diet gives rise to paralysis and inco-ordination of the hind limbs. Another feature is the occurrence of breeding troubles and reduced fertility. Naturally occurring avitaminosis-A has been reported by several workers. We may quote that described by Elder[30] in Missouri as an example: "Trouble developed in pigs that were well fed, well cared for and which had received a ration that was considered to be adequate in vitamin A content." The most characteristic symptoms observed were diarrhoea, emaciation, muscular inco-ordination, blindness, dermatitis, intense itching, and in white pigs a marked pink coloration of the skin. Resistence to secondary infection was greatly lowered. Marked improvement resulted in 7 to 10 days when the animals were changed to a ration containing adequate vitamin A and cod liver oil. Complete recovery took a much longer time. (Other vitamins also have been absent.)

Dunlop[31] in Britain, when testing out a number of different diets commonly fed to pigs —barley meal, weatings, extracted soya bean meal, pea meal, maize meal and alfalfa—found that the only mixtures on which symptoms of vitamin A deficiency did not arise were those which included maize or alfalfa meals.

It is a common observation in this country that young pigs are especially subject to diseases of the respiratory and intestinal tracts. It is highly probable that many of these conditions are associated with an insufficient vitamin A intake in the food. We have had one instance quite recently where the young pigs and store pigs were dying in large numbers from pneumonia. The piggery was managed on the most up-to-date lines and the ration was apparently as good as is usually fed. There was no evidence that parasitic pneumonia was the cause of the heavy mortality, and bacteriological investigation was equally unsuccessful in incriminating a specific organism. Finally, it was suggested that the diet might be low in vitamin A, and that this deficiency was the cause of lowered resistance to otherwise banal bacteria which were now producing the pneumonia. Dosing all pigs with a cod liver oil of known potency completely

checked further trouble. The evidence was therefore suggestive, but not conclusive, that an inadequate supply of vitamin A in the food was the cause of the trouble.

Another instance of what appears to be vitamin A deficiency in a herd of pigs is under observation at the present time. This may be worthy of note, since practitioners may encounter other similar instances. The pigs belong to a commercial herd in which bacon pigs for curing are produced. Each litter is fed upon a ration which gives good results up to the killing weight of about 170 to 190 lbs. live weight. For the last five years the herd has been maintained by selecting from among the bacon fed groups, such gilts as exhibit superior conformation and performance. These are kept on for breeding. The general conformation, capacity to put on live weight, increase rapidly, and rate of growth are good, but the breeding records are very poor. Gilts come into oestrus irregularly, or may fail to do so. Several services are generally needed before pregnancy results, and litters of four, five and six are commonest. Many of the sows have inadequate supplies of milk, and intermittent attacks of weakness of the hindquarters are shown. The conditions described are showing some improvement with the use of a cod liver oil of known vitamin potency. It appears that in this case we are seeing the cumulative effects of hypovitaminosis which have been in progress for several generations.

With regard to horses, very little is known of the vitamin requirements of this species. However, it would be surprising in view of what is known about other animals if horses were independent of supplies of vitamin A. J. T. Edwards[32] has recently contributed an excellent review of the literature on vitamin A deficiencies in animals in which he stresses the possible relationship of vitamin A deficiency and some of the common unsoundnesses in horses. The hypothesis that the so-called "rheumatic diseases" in horses may be due to a deficiency of carotene in the diet has been advanced by Mitchell[33] and though no experimental proof is as yet available the evidence is extremely suggestive. In the first place, the usual rations fed to horses, *e.g.*, oats, bran and hay, are very low in carotene, especially if the hay has been badly cured, and Mitchell's work seems to indicate that the vitamin A content of the livers of horses fed on such a diet is extremely low. For example, in 78 horses examined the livers of 37 per cent. contained less than 100 B.U. per gramme—in some cases merely a trace; 13 per cent. less than 200; 28 per cent. less than 500, while only six per cent. contained a 1,000 or more. Linton suggests that a herbivorous animal under natural conditions should carry a reserve of vitamin A in the liver equivalent to 1,000 B.U. per gramme (Moore's units). It would seem, therefore, that most of the horses in the series were suffering from deficiency. Furthermore, the nerve lesions described in Mitchell's cases are somewhat similar to those described by Mellanby[22] in dogs and rabbits fed on a known vitamin A deficient diet. As a result of very detailed *post-mortem* examinations on 23 horses suffering from shivering, seven from partial paraplegia and 16 from various other localised conditions, Mitchell states "In all these cases, whether the horse was destroyed because he was a shiverer or for one of the other conditions, the pathological findings were the same—widespread bone and joint lesions and a disseminated local degeneration of peripheral nerves." In view of the above evidence, which we have only briefly outlined, and bearing in mind the similarity of the clinical symptoms to those produced by vitamin A deficient diets in pigs and other animals, the hypothesis that a vitamin A deficiency is the cause of "rheumatic diseases" in horses is entirely tenable.

Vitamin A deficiency has also been reported as being responsible for faulty hoof formation in horses. Edwards, in the article already referred to, quotes the experiments of Klemola[34] carried out upon horses in the Finnish Army, which had shown widespread malformations of the hoof wall and which were suspected to be of dietary origin. "This faulty development of the hoof was seen especially in the spring and among older horses. The defects were an excessive dryness and brittleness of the wall, irregular and defective growth of horn, with the appearance of numerous circular furrows or rings, a tendency towards crumbling and cracking, and frequent splitting and chipping of the wall above the bearing surface, resulting in difficulty in shoeing. The hoof surface was quite rough, the superficial layer having become scaly and showing an exuberant morbid growth, especially above the bearing surface and towards the heel. On these parts the hoof was often covered with a thick spongy crust. No evidence of infections or parasitic invasion was disclosed." There seems little doubt that the rations of the animals were deficient in carotene, for the hay was badly bleached through prolonged exposure while drying in the open, and was also rather mouldy. That vitamin A deficiency was the cause of the trouble was plainly indicated by the improvement in the condition of the hoofs brought about by supplementary grazing, A.I.V. silage, or cod liver oil. "The improvement was marked by a deep furrowing around the hoof at the junction of the malformed and healthy wall, a transformation of the perioplic layer from a state of overgrowth to a thin

shining varnish-like layer, and a vigorous growth of the deeper horn-tube layer of the wall."

Before concluding this section, I should like to refer briefly to a recent discussion at the Central Veterinary Society. Talking of "canine hysteria," Bateman[35] mentioned that in six years 85,000 greyhounds had been through his kennels, yet no case of hysteria had ever appeared. Bateman attributed this to the feeding of fresh green vegetables which were *never* cooked for more than 20 to 30 minutes. His records seemed to suggest that vitamin A deficiency was the cause of hysteria. Mellanby has suggested that cereals may contain a nerve toxin which can only operate in the absence of vitamin A, but this point has not been finally settled. Whether absence of the vitamin is an absolute or only a predisposing factor in canine hysteria is immaterial from the practical point of view. I would offer the suggestion to those of you who encounter the disease that it may be worth while to supplement the ration with cod liver oil, vegetables, or other sources of vitamin A. At the same time, there is also evidence that vitamin B may be partly responsible and therefore yeast may be added to the diet with advantage.

Owing to limitations of space I have had to omit discussion of such diseases as nutritional roup in fowls and pasty eyes in ducklings, which appear to be quite definitely the result of vitamin A deficiency.

Vitamin B Complex

Nothing is known regarding the vitamin B requirements of the larger domesticated animals. In any case, the usual rations fed to farm animals will usually furnish plenty of vitamin B. Cattle can synthesise the vitamin in the rumen.

In chickens, deficiency of vitamin B produces the classical picture of polyneuritis from which the vitamin was first recognised by Eijkman.[36]

Puppies have been reported to suffer from lack of B, showing digestive disturbances, loss of appetite, and paralysis often resulting in death.[37]

An interesting suggestion is that possibly "Stuttgart disease" in dogs is due to deficiency in the P—P factor which is responsible for human pellagra. The evidence is as yet far from clear, but Goldberger and his collaborators[38] have produced in dogs a disease which they call "black tongue" and in which the clinical picture, at least, is similar to that seen in "Stuttgart disease." The symptoms produced experimentally in dogs were necrosis and gangrene of the tongue, and buccal mucous membrane and a bloody diarrhoea. The possible relationship of these two conditions is worthy of further investigation, and it might be useful to try the effect of feeding yeast or other sources of this factor to animals affected with "Stuttgart disease."

Many people believe that deficiency of one or other factors in the B complex is partially responsible for "canine hysteria." There does not, however, appear to be any experimental evidence for this hypothesis.

At the Royal Veterinary College it has been observed that certain cases of posterior paralysis in dogs clear up when fresh brewer's yeast is added to the diet. What the possible relationship with the vitamin B complex is, we are unable to say.

Vitamin C

All the available evidence suggests that the domestic animals do not suffer from lack of vitamin C. It has been suggested that cattle, like the rat, are independent of this vitamin in the food supply and are probably able to synthesise it in the body.[39]

Innes[40] has shown that the dog does not require vitamin C in the food. Five puppies eight weeks old fed on a scorbutic diet showed no evidence of scurvy after 147-154 days. The livers of the puppies were found after death to contain vitamin C. Apparently, therefore, the dog is also capable of synthesising C and storing it in the liver.

Vitamin D

The literature on vitamin D is an extremely extensive one, and in a short review of this kind it would be impossible to deal adequately with what is known about the physiological actions of this vitamin. The position is far more complex than was originally thought, since the action of the vitamin is now known to be intimately bound up with the calcium-phosphorus metabolism of the animal body. There is still, however, no reliable information as to the specific part which vitamin D plays in mineral metabolism. That the vitamin increases the net absorption of Ca and P from the food is clearly recognised, but just how it effects absorption and retention of these minerals is unknown.

Mellanby[41] in this country was the first to show by his work on puppies that a fat-soluble factor was concerned in the aetiology of rickets. A few years later McCollum and his co-workers[42] in America published work which plainly indicated the existence of a fat-soluble factor present in certain substances which was distinct from fat-soluble vitamin A, and which came to be known as the anti-rachitic vitamin. As a result of this work it was for a time thought that absence of vitamin D was the specific cause of rickets. Later work has,

however, shown that rickets is primarily a disturbance of the Ca and P metabolism, and it is now well recognised that the mineral relations in the diet as well as the vitamin are involved. Moreover, in addition to the vitamin itself, it has been shown that ultra-violet light, including sunlight, is also effective in preventing rickets. It appears that the action of the ultra-violet rays can activate certain substances (sterols) present in the animal body or in foodstuffs to produce the anti-rachitic factor.

In regard to the interaction of vitamin D and Ca and P metabolism, the current view is that whilst this vitamin is always required for the normal calcification of bone, the amount of the vitamin required varies with the mineral relations in the diet. The highest amounts are required when the intake of these elements is sub-optimal or when the balance (Ca/P ratio) between them is upset. Thus, Theiler[43] has shown that rickets can be produced in calves on a low P intake despite a very large supply of vitamin D. More recently, workers[44] at Onderstepoort have shown that P deficiency in bovines in the presence of adequate supplies of the vitamin in the form of sunlight invariably leads to rickets or osteomalacia, which they regard as identical pathological processes.

All species of the domestic animals require vitamin D. The largest requirements are needed in young animals during the period of active growth for the normal calcification of bone, but the vitamin is also essential for mature animals, though lesser amounts are required. The amount of the vitamin present in cow's milk is very variable and depends to some extent on the time of the year and on the nature of the cow's diet. For example, "summer milk" has a higher content than "winter milk," due to the fact that the cows are outside and, therefore, exposed to the sun's rays which effect the conversion of cholosterol and ergosterol into vitamin D in the animal body. Skimmed milk at all times has little of the vitamin present and if used for the feeding of calves or other young animals should always be supplemented by the addition of cod liver oil.

Another instance where large supplies of vitamin D are required is in the pregnant female. It is sometimes not clearly recognised that the health of the young animal is to a large extent determined by the adequacy or otherwise of the maternal diet during pregnancy. If the dam is fed on a vitamin D rich diet, the offspring are definitely less susceptible to rickets and allied conditions than when the vitamin D is deficient.

Rickets has been reported in almost all species of mammals, the animals most likely to suffer being those which are kept under intensive or artificial conditions—*e.g.*, pigs, puppies, and chickens. Other symptoms caused by lack of vitamin D are stiffness, bone deformity and enlarged joints. We have had one or two instances this spring in which foals were found to be suffering from rickets. Protection against avitaminosis-D in the domestic animals can most readily be achieved by the use of a cod liver oil of guaranteed potency. For farm animals sun-dried hay is also a good source of the vitamin. The insurance of maximum amounts of exposure to sunlight is also of the greatest importance in young growing animals, and in lactating and pregnant females.

Vitamin E

In a recent issue of the *Veterinary Record*, W. R. Wooldridge[45] has summarised the literature dealing with vitamin E; therefore, I propose to deal only very shortly with this vitamin here.

It has been shown that vitamin E is essential for normal reproduction in rats.[46] Its relation to sterility in livestock has not been satisfactorily demonstrated. Danish workers[47] report success from the injection of wheat germ oil into cows which were coming on heat regularly but failing to settle in calf. These workers also claim that sows which failed to come in heat after farrowing responded to administration of vitamin E.[48] American workers[49] have failed to confirm these results. Also unconfirmed is the claim of Moussu[50] that vitamin E prevents abortion in cattle infected with *Br. abortus*.

There is also some evidence[51] that vitamin E is necessary for the normal function of the anterior pituitary gland, and that its absence is associated in rats with degeneration of the anterior pituitary and hypoplasia of the thyroid gland.

Vitamin E has a wide, if somewhat variable, distribution in the usual rations fed to cattle, and it would appear that farm animals receive ample amounts from the cereals in the rations.

Vitamin Supplements

From the foregoing, it is obvious that the two vitamins most likely to be absent from the diet of animals are A and D. These two vitamins can be supplied by the addition to the rations of a cod liver oil of *guaranteed potency*. It is necessary to use an oil which is fresh, in suitable containers, and which bears some indication of its vitamin potency. A good cod liver oil should contain not less than 500 International Units of vitamin A and 50 International Units of vitamin D. Several examinations have been recently made of oils which were being sold in the open market as veterinary cod liver oil, but in many cases

TABLE I*—VITAMIN CONTENT OF ANIMAL FEEDING STUFFS

FEEDING STUFFS	VITAMINS					
	A	D	E	C	B_1	B_2(G)
HAYS, etc.						
Lucerne, good quality, green	++	++	++	O	+	++
„ poor „	O to +	...	...	O	+	+
Clover hay, good quality	+	++	++	O	+	++
Timothy and other grass hay, good quality ...	+ to ++	+	+	O	+	+
„ „ „ poor „ ...	O to +	...	...	O	...	...
Oat straw, etc.	O	O to +	...	O	...	...
Dried grass	+++	...	...	...	...	...
GRASSES, etc. (Growing, green)						
Green actively growing grass	++	+	++	++	+	++
Lucerne	++	+	++	++	+	++
Clover, green	++	+	++	++	+	++
ROOTS, etc.						
Swedes	O to +	...	...	++	...	...
Turnips, leaf	++	...	...	++	...	++
„ root	O to +	...	...	++	+	+
Mangels, root	O to +	O	...	+	O	O
Carrots, raw	++	O	...	+	+	+
Potatoes	O to +	O	...	++	++	+
Cabbage, green, fresh	++	...	+	+++	++	++
Kale	++	...	++	+++	+	...
Beet pulp, dried	O	O	...	O	...	...
Spinach, fresh	++	O to +	...	+++	+	++
CONCENTRATES						
Barley, whole grain	O to +	O	+	O	++	+
Oats, „	O to +	O	+	O	++	+
Oatmeal	O to +	O	...	O	+	+
Maize, white, whole grain	O	O	+	O	++	+
„ yellow „	++	O to +	+	O	++	+
„ „ gluten feed	++	O	O	O	O	...
Wheat, whole grain	O to +	++	O	O	++	+
„ bran	O to +	O	+	O	++	+
„ middlings	O	O	++	O	++	+
„ germ	+	O	+++	O	+++	++
„ flour, white	O	O	...	O	O	O
Linseed	++	O	+	O	...	...
„ cake	+	O	...	O	...	...
Earth-nut meal	O	O	++	O	++	...
Soya bean meal	O	O	...	O	++	+
FOODSTUFFS OF ANIMAL ORIGIN						
Cod liver oil	+++	+++	O to +	...	...	...
Halibut „	+++	+++	...	...	...	...
Cow's milk, whole, fresh	+ (varies)	O to + (varies)	+ (varies)	+	+	++
„ „ skim, „	O to +	O	+	O to +	+	++
„ „ whole, dried	+ (varies)	O to + (varies)	+ (varies)	O to +	...	...
„ „ „ pasteurised	+ (varies)	...	...	+	...	...
„ buttermilk	+	...	...	O to +	...	...
Milk whey	O	O	+	O to +	+	+
Eggs, fresh	++	++	...	...	+	+
Beef, lean	O to +	...	++	O to +	++	++
„ fat	++	+	...	...	...	...
Ox heart	...	...	...	...	++	...
„ liver	+++	...	++	...	++	+++
Blood meal	O	O	...	...	...	...
Mutton	...	...	...	O to +	++	++
Pork	O to +	...	...	O to +	++	++
Fish, white	O to +	...	...	...	+	...
„ meal	O to +	O to +	...	O	O	O to +
Yeast, brewer's	O to +	O	O to +	O	+++	+++

In the table, O signifies that the vitamin has been tested for and not found, + that the foodstuff contains the vitamin, ++ that it is a good source of the vitamin, and +++ that it is a rich source; the sign ... that no references to tests have been found in the literature.

* The data in the table have been compiled from various sources. Particular acknowledgement is made to "Vitamins: A Survey of Present Knowledge." M.R.C. Spec. Rep. Ser. No. 167, and to "Feeds and Feeding," Morrison, F. B. (1936). (Morrison Publishing Co., Ithaca, New York.)

these oils have turned out not to be cod liver oil at all. In one instance of twelve oils examined, only one was considered to have an adequate vitamin potency, whilst the others were cod liver oil or other fish oils adulterated with mineral oils, and in one case mineral oil alone. Such a state of affairs is pure exploitation of the farming industry and responsible advisors to the farming community should recommend only the use of oils from reliable firms and which bear a statement of the vitamin potency on the label. The oil should preferably be bought in small amounts as required, since the vitamin potency is liable to deteriorate with keeping. One gallon tins will be found the most useful and they should be stored in a cool place. In this connection it must be borne in mind that vitamin A is especially liable to oxidation in the presence of air and light and, therefore, the containers should always be made of a substance impervious to light and should be tightly stoppered to exclude air as far as possible. This is especially necessary if the oil has to be kept for any length of time.

As regards the method of feeding cod liver oil, it should not be mixed up in bulk with the food and then left exposed to the air for any length of time. The best system to adopt is to add it separately to the individual rations just before they are given to the animals. In this way, the danger of vitamin A being oxidised is diminished and also each animal is more likely to receive its appropriate dose.

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Discussion

Mr. K. D. Downham, who opened the discussion, said he was glad to have the opportunity of drawing attention to this very important question of nutrition in relationship to disease control in farm stock. He believed that the veterinary surgeon had a most important part to play in connection with methods of animal husbandry, and it was because they had not been asked to take part to any extent in the development of modern feeding methods, that there was so much loss in animals from this cause.

Mr. Scorgie had asked him to speak about the rôle of vitamins in the nutrition of poultry and his experience had shown him that deficiency diseases in poultry were present to a very large extent all over the country.

Dealing first of all with vitamin A, it was his experience that the developing chicken, as well as adult poultry, had a very high requirement for vitamin A, and this accessory factor was commonly not supplied in the food. It had been found that young chicks deprived of this vitamin did not manifest signs of deficiency until the age of two or three weeks, probably because of the supply of vitamin A in the egg yolk, but many eggs produced under modern conditions contained an inadequate amount of this vitamin, and disease due to this cause might appear earlier. The symptoms included inco-ordination of movement, staggering gait, crouching on the hocks, soreness or pastiness of the eyelids, but ophthalmia rarely was seen, probably because the chicks did not live long enough, death taking place three or four days after the onset of symptoms, and the mortality frequently exceeding 40 per cent. On *post-mortem* examination various forms of nephritis were found to be present. The particular function of vitamin A was to nourish and maintain in a healthy state the epithelial linings of the body, and in deficiency of this vitamin the protective mechanism of these cells was either destroyed or seriously damaged, resulting in secondary bacterial or virus infections. In the upper respiratory tract the cells of the glands and their ducts were chiefly affected, and it might be impossible to differentiate between a severe vitamin A deficiency and certain specific infectious diseases.

A high percentage of the poultry stocks of the country suffered from coryza or colds, and it was common to find 50 per cent. of the birds entering the various laying trials to be affected in this way. The experience of a breeder, whose birds until this year had always suffered from colds, was worth recording. This man decided to feed liquid skim milk to his chicks as soon after hatching as possible. His practice was to give water for the first 48 hours to get them used to drinking, after which for three of four days he used equal parts of water and skim milk in the drinking troughs. When the chicks were eight or nine days of age they were given skim milk with no water added, and that was the only liquid they received from then onwards. Since that method was adopted he had not had a bird with a cold on his premises, and when he (Mr. Downham) examined his pen of birds at the commencement of a laying trial, they were the heaviest birds entered and were in perfect health.

The value of fresh green food as a source of vitamin A could not be over emphasised. Good grass, clover, kale, cabbage, chives, lettuce and spinach, particularly the latter, were all excellent sources of this essential food factor. [Mr. Downham referred to the work of Beach (1924), Hughes, Leinhardt and Aubel (1929), and Seifried (1930).]

Speaking next of the experiments of Henshaw (1934), Mr. Downham said that it had been found that chickens and turkey poults reared together and fed on a vitamin A deficient diet resulted in a mortality of 100 per cent. by the forty-fifth day in the case of the turkeys, and the mortality was the same in the chickens by the sixtieth day, whereas no mortality occurred in similar groups of birds which received 8 per cent. of dehydrated alfalfa meal. In his (Mr. Downham's) experience the turkey had a higher requirement of vitamin A than the chicken. There was no doubt that most of the poultry flocks of the country at the present time suffered from partial deficiency, and that this condition was accentuated during certain seasons of the year when green food was inadequate. This was evident from the low hatchability of eggs, the susceptibility to colds and the increase in non-specific infections.

Vitamin A deficiency in rats with extensive degeneration of nerve fibres had been reported by Zimmerman (1933) and others, and there was no doubt that under certain conditions all animals suffered severely from lack of this substance. Heavy losses in sheep occurred on a farm where the animals received an inadequate supply of vitamin A, one of the characteristic symptoms in this case being that of blindness.

Chickens had a high requirement for the vitamin B complex, and this was sometimes seen following certain processes of treating grain. General polyneuritis with a high mortality followed the use of pellets for chickens in the early stages of their use, before the process of production was adjusted. Yeast and unmilled grains supplied this vitamin.

Poultry had the ability to synthesise vitamin C in the body. Holst and Holbrook (1933) reported the existence of a scurvy-like disease in chicks resulting in bleeding from the pin feathers and severe haemorrhages in various parts of the body. *Post-mortem* examination showed erosion of the gizzard in 95 per cent. of the affected birds. Birds kept under very intensive conditions and receiving no fresh green food appeared to be subject to a scurvy-like condition with bleeding cysts and haemorrhages all over the body.

The work of McConkey and Smith (1933) showed the importance of this vitamin in relation to disease. These workers fed 37 guinea-pigs on a vitamin C deficient diet and they received daily doses of tuberculous sputum for a period of several weeks. Twenty-six of these animals developed tuberculous ulcers in the intestines, whereas of 35 animals fed with a good source of vitamin C, only two developed tuberculous lesions after receiving the same daily doses of tuberculous sputum. Recent experiments by Downham and Venn with ducks appeared to show that the duck was capable of considerable resistance to tuberculosis, and these

birds under normal conditions very rarely showed vitamin deficiencies.

All types of fowls had a high requirement for vitamin D, and it was found that on account of the high growth rate of turkeys these birds were particularly liable to suffer from rickets. Deficiency of vitamin D influenced the mineral metabolism and caused, in addition to a disturbance of the deposition of the bone salts in the epiphyseal cartilages, general porosis, thin egg shells and cessation of laying. As little as 0·1 per cent. of the sun's radiant energy had anti-rachitic power in many parts, and exposure of only ten minutes per day was sufficient for the requirement of chickens. Late-hatched birds from birds which had produced a large number of eggs and the winter production of chickens predisposed poultry to vitamin D deficiencies. The symptoms shown were soft or rubbery beaks, inco-ordination of movement due to change in the ends of the bone, deformity and distortion of the ribs. Nephritis was often present and the mortality might vary between 5 and 40 per cent. The mixing of a potent cod liver oil to the ration shortly before use was essential, together with the supply of as much direct sunlight as possible, and a liberal quantity of oyster shell.

Vitamin E was essential for fowls, and many breeders had experienced an increased fertility by feeding sprouted wheat and abundant green food. In his opinion the value of skim milk and green food for poultry could not be over-emphasised and he was of opinion that if these foods were used to a far greater extent than was now the case, there would be a very considerable reduction in the loss from non-specific diseases, which at present accounted for a higher mortality than all types of infectious diseases.

[Mr. Downham then demonstrated radiographs of turkeys and chickens suffering from deficiency diseases.]

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General Discussion

Mr. Tudor Hughes, who followed, observed that what they had to do was to take back with them the scientific information they had gained and put it into practice. With regard to the great difference in the quality of cod liver oil, stressed by Mr. Scorgie, he thought something ought to be done under the Food and Drugs Act to prevent such adulteration. The less cod liver oil was tampered with, the higher its vitamin content should be. He wondered whether the so-called tasteless cod liver oil had the same vitamin value as the tasty stuff sold as veterinary. The difficulty was to get an animal to take it, and he found that the best way was to shake it up and give it with milk. They had seasonal problems in practice, and they were now approaching the time of the year when they had to ask themselves what was the best time of action for getting mares and cows to improve their fertility standard. Thoroughbred and hunter mares would have been kept indoors and fed on dried and concentrated foods. Was such diet conducive to fertility? Or, was it desirable to get such animals on the early grass? With regard to vitamin B, they were told that the best source was fresh brewer's yeast, but unfortunately there was no brewery in Oswestry, where he (Mr. Hughes) lived. Would baker's yeast do instead? He thought this question of vitamins was closely interwoven with the question of minerals, and it would be interesting to know whether the mineral value of food was in keeping with its vitamin contents. He was very interested, also, in the suggestion of unsoundness being due to lack of vitamins, more particularly A and D. He was inclined, especially in the case of shivering, to the view that heredity was the primary factor in unsoundness in the horse, and he thought there had been a great improvement since the Ministry of Agriculture went in for the licensing of stallions. It was a pity it was not extended to the female, but the fact remained that they did not see as many shiverers as they used to do. He believed, also, that there were fewer Shire horses of unsound wind, but they should keep heredity in mind as a first principle.

Mr. H. W. Steele-Bodger asked if it were not possible that certain ailments were due not necessarily to a deficiency of vitamin A, but to an hereditary tendency to be unable to assimilate vitamin A. How many of them could say, having tried these vitamin specifics for this and that disease, that he was able to satisfy his conscience that he had derived indisputable benefit from them? He had sometimes managed to persuade himself that it was so, but all things considered, he was not fully satisfied. Mr. Scorgie advised cod liver oil, but one was startled by his remarks on the adulteration that took place. One ought to have a guarantee that it contained the proper percentage of vitamins.

Mr. F. Chambers said that, with regard to vitamin A deficiency, it had never struck him that the absence of so many diseases among horses in South Africa was due to the fact that they got a diet very rich in vitamin A. In the absence of grass, they were fed on a diet of maize and oats, hay cut green and dried. While he was in South Africa he never saw a single pony with spavin, ring-bone or side-bone, and the only horse he saw with arthritic disease was an English charger, left over from the Boer War, which had a large, well-defined spavin. That might have been partly due to the fact that there were no metalled roads, and the horses were not shod. Nor did he see a case of specific ophthalmia in South Africa, whereas in Northern Rhodesia, where the animals lived for six months on dry grass and anything they could pick up, specific ophthalmia was prevalent. An interesting remark by Mr. Scorgie was in regard to calculi. In the canine species, he thought the dogs which were the biggest sufferers from calculi were Pekingese.

An owner was told to feed his dog on raw meat with the fat cut away and water, and it was brought to him (Mr. Chambers) with a calculus. He could not speak too highly of the efficiency of yeast in certain cases. He had two or three hunters that were not doing well, and he tried baker's yeast. They began with bits as big as peas mixed with their bran and oats, and these pieces were increased in size until they got as big as a walnut, the change from the pea to the walnut taking about three weeks. Those animals finished the season in respectable condition. As to sterility and vitamin E, he thought it was a moot point whether it was vitamin E or vitamin B_1. Farmers had told him that young heifers would not go to the bull, but when they were turned out to grass they did so. That surely was due to the influence of vitamin B_1, suggesting that vitamin E had nothing to do with it.

Mr. W. F. Aston said he was afraid some of his comments might be regarded as antagonistic, but that did not mean that he had not enjoyed the paper. He understood Mr. Scorgie to say that hay that was sun-bleached was deprived of 80 per cent. of vitamin A. He would like to know whether there was any special value in the Scottish method of making big haycocks and not exposing so much to the sun. He was surprised to hear Mr. Scorgie say he had only just become aware of rickets in thoroughbred foals, for he (Mr. Aston) had seen that ever since he had been in practice. They had heard, too, Mr. Downham's remarks that milk was a good thing for chickens, as though it was something new. "My grandmother," said Mr. Aston, "always gave her chickens milk, and fed young turkeys on butter milk." Instead of spinach, they were satisfied to get the tops of nettles. He could not say what their vitamin value was, but they were certainly cheaper. As to the use of yeast, sometimes his patients had done well on it and sometimes not. While he agreed that young grass in May and June was full of vitamins, he thought its real value was the balanced diet, eating nature's food.

Mr. O. V. Gunning commented that he was wondering whether in his district, where milk production had been carried on for many years, without much being put back on the land, the pasturage on such land was all it might be. It was said that cattle should be given green food all the winter, but what green food was available? After the kale had gone, they might say that roots had no vitamin value, so what vegetable food was left? With regard to boiled vegetables, the housewife put soda in the water to give them a nice green colour, and he would like to know whether that lowered their vitamin value.

The Reply

Mr. Scorgie, replying to the discussion, thanked Mr. Downham for having dealt with poultry, in regard to which he himself had very little experience.

Various speakers had brought up the question of cod liver oil, particularly in respect of adulteration and the sale of such "veterinary cod liver oils" as were, in fact, not produced from cod livers at all. The best advice he could give them at present was to buy only from reputable firms which sold cod liver oil with a guarantee of the vitamin content on the label. The sale of spurious oils was a matter which was causing great concern amongst *bona fide* producers. He (Mr. Scorgie) was a member of a committee of the British Standards Institution which was at present considering this question. This committee hoped to issue, within the next few months, a specification as to vitamin potency and chemical properties of cod liver oil for animal use. It was hoped that this specification would be a safeguard to the buyer. In reply to Mr. Tudor Hughes, Mr. Scorgie did not consider that the taste of cod liver oil had any relation to its vitamin content. A good oil should have a slightly fishy odour, be bland to taste and be free from all traces of rancidity. There was no evidence to suggest that the vitamin content of a food was related to its mineral content.

With regard to fertility in thoroughbred mares kept indoors and fed on concentrates, he did not thing that such a diet was conducive to maximum fertility. It was well recognised among thoroughbred breeders that there was more chance of getting a mare in-foal after the young grass had started growing than in the earlier months of the season. As to baker's yeast as a substitute for brewer's yeast where the latter was not obtainable, it would provide an adequate vitamin B supply.

With regard to the common unsoundnesses in horses, the position was still far from settled. All that could be said at present was that there might be something in the dietary deficiency hypothesis. Mr. Chambers' remarks on the absence of bone diseases of horses in the tropics was further circumstantial evidence to support the hypothesis. As to the relation between the domestic animals and vitamin E, he agreed with Mr. Chambers that this was still a moot point, but there were no grounds for supposing that sterility in cattle was in any way connected with vitamin B_1 deficiency. Cattle had been shown to manufacture this vitamin in the rumen through the medium of bacterial action.

In reply to Mr. Aston, Mr. Scorgie did not consider that there was any special value attached to the Scottish method of making hay, since the greatest loss in carotene took place when the hay was still lying in the swathe and before it was put into cocks. The reference to rickets in thoroughbred foals was not meant to convey that this was a new condition; it was merely given as an example that rickets could occur under what might be expected to be the best conditions of horse breeding. Mr. Aston's reference to his grandmother feeding her chickens on milk was no doubt interesting, but it was a fact to-day that commercial poultry feeders did not use milk. The value of milk, however, was well known and an increasing number of firms now included milk powder in their feeding meals.

In answer to Mr. Gunning, he agreed that it was sometimes a very difficult matter in practice to arrange a supply of green food throughout the winter, particularly in certain districts where arable farming was not carried on. One method of securing green food was ensilage, which some authorities considered a more valuable foodstuff than dried forage. In regard to boiled vegetables, there was some evidence to show that greens boiled in the usual household manner did not lose a great amount of their carotene content.

For failing to obey Ministry of Agriculture notices to castrate or kill two bulls, a Surrey farmer was fined £5 on each summons at Croydon. Five guineas costs brought the total to £15 5s.

The Veterinary Record

June 25th, 1938.

The Rôle of the Vitamins

THE long disputed existence of vitamins is to-day accepted and their use and abuse in the rearing of animals is almost as common as their similar rightful and wrongful employment in human nutrition. But as knowledge becomes ever more definite the abuse of such factors as vitamins will lessen and their proper use increase. With greater knowledge of the true value of vitamin preparations and foodstuffs and with a more exact appreciation of the symptoms actually arising from an insufficiency of one or more of the vitamins a more correct prescription of the appropriate remedy will follow.

Of recent years great advances have been made in our knowledge of vitamins. Several of them, such as vitamins C, B_1, B_2 and D have been obtained in the pure state and some have actually been synthesised. The true physiological and pathological importance of these pure compounds is being rapidly disclosed. The physiological activity of related compounds is being examined and knowledge of the chemical structures responsible for this activity will follow. The number of active substances increases as the existence of provitamins, such as the carotenes for vitamin A, and of related active compounds, such as the recently-discovered vitamins D_2 and possibly D_3, is discovered. Vitamin C still remains simple but the old vitamin B complex is comparatively slowly disclosing its true nature. Vitamin B_1, the antineuritic vitamin, has been isolated and synthesised and is now usually called aneurin; the original vitamin B_2 is now split into lactoflavin and vitamin B_6, the former now usually being called vitamin B_2. Other B factors are postulated, such as the antipellagra factor for human beings and the anti-black tongue factor (probably a different entity) for dogs.

Yet despite the tendency for the number of vitamins to increase, the extent of the knowledge recently gained by the huge army of research workers engaged on these problems enables clarification to be secured. The introduction of standardised methods of assay using, at each test, accurate doses of stable International Standards for the different vitamins has very materially helped this advance in knowledge. Already it has enabled a useful compilation of Tables giving the Vitamin Content of (some) Human and Animal Foods* to be published, a table which our readers will find more useful in some respects than that we publish in the article by Mr. Scorgie.

In spite of the enormous advances made by the experimentalists, our knowledge of the rôle of the various vitamins in the economy of the farm animal still remains limited. We hope that this deficiency in veterinary knowledge will improve rapidly in the near future and that both research worker and clinician will add his full quota to the advances we confidently expect.

*M. A. Boas Fixsen and M. H. Roscoe. Nutrition Abstracts and Review, 1937-38. 7. 823-867.

ZOOLOGICAL SOCIETY OF LONDON

The President of the Zoological Society of London, Lord Onslow, speaking at the recently held annual meeting, said that a matter for the future which might be kept before the public was the establishment of a national park, in which many of our species of animals might be preserved as animals were preserved in other countries.

In his earlier remarks, the President stated that since 1903 the income of the Society had increased from £30,000 to £150,000. In view of this remarkable advance, together with the development of Whipsnade, the Council had taken certain steps to place the organisation of the Society on an appropriate footing, including the re-drafting on up-to-date lines of the bye-laws, and the appointment of Mr. F. W. Bond as Assistant Treasurer. Another new appointment was that of Consulting Architect, which Professor W. G. Holford had been offered and had accepted.

Additions to the collection of animals at the Zoo had been greater in numbers than in past years and many of them of considerably greater interest than had formerly been the case. In the first place he would mention the gift of four Arabian camels by King Ibn Saud which would shortly be on view. The most important new exhibit was the male Okapi presented by the King of the Belgians to King George and deposited with the Society. They were also indebted to Sir George Macdonogh for a pair of flesh-eating giant bats, the first to reach Europe alive.

It was proposed shortly to open a Children's Zoo on the site in the Park Paddocks. This would take the place of the old Pets Corner, to which certain objections had been raised, and it would be an entirely revised and improved scheme in which the educational facilities would be increased.

Progress was being made with the construction of the new Elephant House and it was hoped that it would be opened this year by the Maharajah Raol Shri Krishnakumarsinhji Bhavsinhji of Bhavnagar, by whose gift the building had been made possible. Before long a reptilarium would be installed at Whipsnade.

Lord Onslow was re-elected President of the Society; Major Albert Pam, Treasurer, and Dr. Julian S. Huxley, Secretary.

ABSTRACTS

[Vitamins: Their Importance for Man and Animals. Albrecht, A. (1937.) *Münch. tierärztl. Wschr.* **88.** 277-379.]

Vitamins are protein-like substances minute amounts of which are necessary for the proper functioning of the body cells. Under natural conditions a sufficiency of these substances is taken in with the food since they occur especially in green foods, foods rich in oil and animal products. However, many are lost in the present-day manufacturing processes to which foods are submitted; also, animals kept under artificial conditions may not receive enough of them in their diet.

Vitamins are intimately associated with the mineral constituents of the body cells, the two together affecting the surface tension, activity, adsorption, permeability and metabolism of the cell. In addition all vitamins with the exception of vitamin C are concerned with cell oxidations. There is also a connection between vitamins and hormones not only chemically but also in their actions. It seems possible that vitamins enable vertebrates to form hormones but it does not follow that avitaminosis is simply an hormonal disturbance due to an upset of the cell metabolism.

All vitamins are built up by plants but many of the higher animals also possess this power, as in the case of vitamin C, or else they can form them from the provitamin of the plant as in the case of vitamins A and D. In the plant cell, by the action of chlorophyll and sunlight, inorganic material is converted into living matter chiefly by oxidation or reduction processes. The majority of vitamins assist such reactions so that with their aid, animals can carry out these processes without the necessity for direct sunlight.

In addition to their food value, ever since the connection between scurvy and a lack of vitamin C in the diet was established, it has become apparent that vitamins play an important part in the prevention, cure or aetiology of certain diseases. It has been clearly shown that a disturbance of health may follow from either a hyper- or a hypovitaminosis. Hypovitaminosis may be regarded not so much as due to a lack of any one particular vitamin but to a complex disturbance which depends on other dietetic factors as well. Thus, for example, it has been shown that the simple addition of a particular vitamin lacking in a diet may produce little effect unless the other constituents of the diet are in correct proportions. Congenital diseases may sometimes be due to a deficiency of vitamins in the diet of the mother which disturbs the development and metabolism of the foetus.

Fat soluble vitamin A with its precursors α-, β-, γ- and probably δ-carotin, cryptoxanthine and retinin is an anti-xerophthalmic vitamin occurring chiefly in cod liver oil, butter, milk, tomatoes, hay, etc. Lack of vitamin A in the diet is followed by degenerative changes in the skin and mucous membranes, disturbance of the C.N.S., ophthalmia, cessation of growth, cystitis and gastro-enteritis. Hypervitaminosis A causes in mice and rats loss of weight, falling out of the hair, fatty degeneration of the liver, haemorrhages in the lungs and intestine and hypertrophy of the thyroid glands. There also appears to be a connection between vitamin A and the reproductive glands since it has been possible to influence the sexual cycle by the administration of the vitamin.

Water soluble vitamin B consists of seven factors, B_1 to B_7. B_1 is an anti-neuritic vitamin found especially in yeast, wholemeal bread, liver, heart muscle, etc. Lack of this vitamin causes a disturbance in water storage and carbohydrate metabolism as well as neuritic disturbances. In pigeons and hens it causes beri-beri. Vitamin B_2 is a pigment also known as lactoflavin, vitamin G or the P-P factor. It is intimately connected with growth and occurs in heart, liver, kidney, green plants, yeast, milk, etc. A deficiency of this vitamin causes digestive disturbance, nervous symptoms and degeneration of the mucous membrane of the tongue and mouth. Its activity appears to be closely associated with the chromaffin system. In dogs, a lack of vitamin B_2 produces gastro-enteritis and disturbance of the C.N.S.; if at the same time vitamin B_6 is deficient in the diet the condition known as black tongue is produced.

Vitamin B_3 is necessary for the proper growth of pigeons. A lack of this vitamin causes a disturbance of metabolism in these birds. Lack of vitamin B_4 causes in rats cessation of growth and atrophy of the muscles; if at the same time there is a lack of B_1 and B_5 polyneuritis develops. In man a lack of B_4 and B_2 produces the condition known as pellagra. Cats appear to be particularly sensitive to a lack of B_4. Vitamin B_5 is essential for the growth of pigeons. If vitamin B_6 be absent from the diet of dogs and rats a condition resembling pellagra of man is set up.

Water soluble vitamin C is the antiscorbutic vitamin. It has been prepared synthetically and occurs chiefly in plant material, also in liver, spleen and kidneys, but milk is by no means always rich in vitamin C. Lack of the vitamin produces the well-known symptoms of scurvy. Rats, dogs, young pigs and rabbits are able to manufacture their own vitamin C; similarly ruminants can do without a supply of the vitamin in their diet.

Fat soluble vitamin D is the anti-rachitic vitamin. It is very sensitive to ultra-violet light and shows a close similarity to vitamin A. It occurs in the food as a provitamin and is converted into the active vitamin not by enzymes as in the case of vitamin A but by the action of sunlight. The body itself cannot activate the provitamin, normally this is done by ultra-violet light. The provitamin is known as ergosterol. Calciferol, also called vitamin D_2, which has been prepared synthetically, is not identical with vitamin D although their activities are similar. Lack of vitamin D or the insufficient exposure to ultra-violet light is followed by rickets. Over-dosage with vitamin D upsets the balance of the thyroid- parathyroid glands and is followed by osteomalacia, tetany, eczema and allergic diseases. Hypovitaminosis D may be prevented by the simultaneous assimilation of increased amounts of vitamin A and *vice versa*.

Fat soluble vitamin E is the anti-sterility vitamin which occurs chiefly in wheat germ, seeds, oats and green foods. Recent work indicates that it consist of two factors, of which one is essential for the proper development of the male reproductive organs and the other for the female. A lack of vitamin E in the diet of male rats is followed by degeneration of the testicular epithelium and the faulty development of spermatozoa. No effects are produced in female rats for some considerable time. The sexual cycle remains undisturbed and the growth and number of the young produced at the first pregnancy after there has been a deficiency of vitamin E is perfectly normal. However, usually at the third pregnancy, autolysis and absorption of the developing foetuses takes place. It is not definitely known whether vitamin E is necessary for man. It is probably in some way connected with the anterior pituitary gland.

A lack of vitamin F in the diet of rats is followed by necrosis of the skin, sterility and uraemia, but whether this is the case in other animals is not definitely known.

Water soluble vitamin H appears to be essential for the proper utilisation of fats and certain proteins in children and the amount required is proportional to the body weight. In rats, lack of vitamin H is followed after some months by inflammation of the skin, blépharitis and falling out of the hair. Seborrhoea in man is probably due to the same cause.

Vitamin J protects against bacterial infection and has been called the anti-pneumonic vitamin.

Fat soluble vitamin K has a certain resemblance to vitamin E. It is anti-haemorrhagic and is recognised by its action on the clotting time of blood.

J. A. N.

[Relation of Canine Distemper to Avitaminosis. Scheunert and Petzold. (1937.) *Tierernährung.* **9.** 147-172.]

The nervous form of canine distemper is accompanied by symptoms similar to those observed in experimentally produced avitaminosis B_1 and A. Some evidence in favour of a relationship between the two conditions was obtained from the literature and the authors endeavoured to investigate the problem experimentally.

Irradiated brewer's yeast rich in vitamins B_1, B_2 and D, was used as a source of vitamins and this was fed to two pregnant bitches during the last few days before parturition and until the puppies were weaned. Unfortunately, it was found impossible to infect with distemper either these puppies or controls. This failure was probably due to a loss of virulence of the infected blood used for inoculation.

Young dogs fed supplements of irradiated yeast over periods of several months failed to develop an immunity to distemper.

A complete diet, irradiated yeast, or pure vitamin B_1 had no effect on the course of distemper infection; cod liver oil was similarly without effect.

It is concluded that canine distemper probably is not related to vitamin deficiency.

E. G. W.

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[Fowl Leukaemia and Vitamin E. (A Preliminary Report.) Butler, W. J. and Warren, D. M. (1938.) *J. Amer. Vet. Med. Ass.* **45.** 204.]

Attention is drawn to the heavy losses in America among poultry from fowl leukaemia "expressed as fowl paralysis." Reference is made to the observations of Adamstone who in 1936 pointed out that chicks fed with food in which the vitamin E was deliberately destroyed, developed a condition "strikingly similar to leukaemia."

The authors have carried out experiments in which about 1,000 paralysed birds were used to test the value of the use of vitamin E as contained in cold-pressed wheat-germ oil as a curative agent. The oil contained approximately 40 Pacini-Linn units of vitamin E per gramme and was injected in doses of 1 to 2 c.c. subcutaneously. Rapid recovery from paralysis following the injection is reported and it is stated that "apparently, the injection of wheat-germ oil checks the leucocytic infiltration and may direct its resorption so as to release the fibres of nerves entrenched in its meshes." It is also stated that the altered blood picture tends to return to normal. The use of wheat-germ oil is said to be as effective by feeding as by its injection both in influencing the course of the disease in the affected

bird and in preventing the occurrence of further cases to any extent in an already affected flock. T. D.

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[**Short-Wave Therapy.** Briton, N. W. (1937.) *Austral. Vet. J.* **13.** 6. 247-249.]

The author briefly describes in general terms the apparatus used for producing short-waves. An explanation is given of the difference between this type of apparatus and the type used for producing high frequency currents.

It is pointed out that in the short-wave apparatus the patient's tissues are not actually in contact with the apparatus but that the appropriate part is placed between two plates connected with the secondary oscillating circuit, the patient's tissues thus acting as the dielectric of a condenser in this circuit.

The effects of short-wave radiations are then discussed and it is pointed out that while in part the effects may be explained on the basis of heat production in the tissues, experience has shown that a greater measure of hyperaemia is produced than by a corresponding degree of heat. By adjusting the frequency of the oscillating circuit it is possible to influence one tissue more than another, *e.g.*, bone more than the muscles surrounding it. The intensity of the reaction in any tissue will, of course, depend on the output of the apparatus.

The merits of short-wave therapy over diathermy are discussed; in diathermy, owing to dispersion of the current over the body it is not possible to treat deep tissues so effectively as by short-wave therapy.

The method of controlling the output of the apparatus is then described.

The article concludes with references to the type of case in veterinary practice that might respond to short-wave therapy. There are no references to cases actually treated with the short-wave apparatus. G. F. B.

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[**Variation in the Character of the Fluorescence in the Test for Pregnancy in Equines.** Cuboni, E. (1937.) *Clin. Vet. Milan.* **60.** 7. 375-380.]

Cuboni's test for pregnancy is based on the chemical demonstration of follicular hormone in the urine of gravid mares. Fifteen c.c. of urine and three c.c. of concentrated hydrochloric acid are heated in a water bath at boiling point for ten minutes. The mixture is cooled under a tap, poured into a separating funnel, 18 c.c. of benzol added and the mixture shaken. The benzol layer is collected, poured into 10 c.c. of concentrated sulphuric acid and heated in a water bath at 80° C. for five minutes. The mixture is then cooled again and, in the case of pregnant animals, a green fluorescence develops, whilst in non-pregnant animals no fluorescence appears.

Continuing his observations on this test, the author investigated the reaction of the urine of 13 mares in various stages of pregnancy and was able to confirm the observations of Karmann, that a positive reaction first appeared about 120 days after conception. He found that, in some mares, in the early stages of pregnancy, the fluorescence might be blue or blue-green, but as pregnancy progressed the fluorescence turned to the characteristic green, even in animals whose urine, in the early stages, had given a blue reaction.

U. F. R.

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[**Blood Transfusion in Dogs.** Bower, C. W. (1938.) *J. Amer. Vet. Med. Assoc.* **92.** 2. 136-142.]

The indications for blood transfusion are severe shock following haemorrhage, anaemia and infectious diseases such as distemper. The rise in blood pressure following blood transfusion is more permanent than when normal saline solution is injected.

The writer considers that the most practical technique is from the heart of the donor (anaesthetised with barbiturates) to the peritoneal cavity of the recipient. The amount given is from 50 to 200 c.c. There is stated to be no danger of incompatibility when this method is adopted. It is suggested that in emergency cases blood should be injected direct from the heart of the donor to the heart of the recipient. The vein to vein technique is not very practical. The indirect method using citrated blood is noted.

The writer, as a result of clinical experience, expresses the view that the intramuscular injection of small quantities of the patient's own blood is a valuable line of treatment in a variety of conditions, such as eczema. He is not able to put forward an adequate explanation for the mode of action. An isolated case treated by this method is described.

In the discussion which followed, Dr. J. V. Lacroix drew attention to the storage of citrated blood by refrigeration. He noted that the Mayo clinic advises that such blood is useable for a period of twelve days, although this period may be extended up to one month.

J. W. H. H.

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[**Some Physiological Abnormalities in Certain Forms of Eczema in the Dog.** Martin, A., Brizard, A., and Florio, R. (1937.) *Rev. Méd. vét.* **89.** 561-576.]

The authors review at some length the various theories concerning the causes of eczema. Recent work prompted them to carry out chemical examinations of the blood of dogs affected with eczema. Eight cases are described fully in the paper. Six of these showed

a reduction of chlorine in the blood plasma and an increase of urea in the blood. Treatment of these cases by intravenous injections of 20 per cent. sodium chloride at three day intervals brought about a complete cure. The physiological aspects of the cases are described at some length. The authors conclude by mentioning the many avenues of research which might be studied to elucidate the many problems associated with eczema.

D. W. M.

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[**Granulotherapy. (Intravenous Injections of Charcoal.)** Liegeois, F. and Terache, P. (1937.) *Ann. Méd. vét.* **82.** 10. 401-408.]

After mentioning in brief the treatment of generalised infections by antiseptics, protein and colloid therapy the authors review the work carried out on a recent method—granulotherapy. Granulotherapy consists of intravenous injections of a fine suspension of charcoal at regular intervals and in appropriate doses. A 2 per cent. concentration of charcoal in distilled water or normal saline is used. There appears to be a certain danger attached to the method if the charcoal particles are too large or too small, and the ideal suspension contains particles five to 15 microns in diameter. The effects of the injections on the animal body are discussed. The authors have used the method on dogs with good results in the treatment of non-specific infections and *post partum* metritis. D. W. M.

ANIMALS ON ESCALATORS

Because of the difficulties caused by pet animals being taken on London Underground railways, and especially the tubes, the London Passenger Transport Board has issued warnings to the staff that the bye-laws relating to the carriage of animals must be rigidly applied.

The most frequent cause of trouble is the practice by thoughtless people of taking dogs on the moving escalators. Warnings are posted stating that passengers must not take dogs on the moving staircases unless they are prepared to carry them. The rule is strictly enforced by the staffs, for the modern comb type of escalator, which "combs" the passenger off at the top or bottom of the escalator so that he cannot trip, cannot be made in such a way as to prevent the risk of a dog's nails or paws being trapped. Every year the names of about 50 persons are taken for failing to act according to the regulations: some are prosecuted and others are cautioned.

Apart from the danger of the animal being hurt on the escalator there is always a danger that it may get on the line and be killed. London Transport officials recognise that some dogs are temperamental and that it is not easy to carry large dogs, but the safest plan is to lead a dog up or down a staircase or stationary escalator. If all escalators are working, members of the station staffs have instructions to direct passengers with dogs to the emergency staircases provided at every station.

REVIEWS

[**Biological Standardisation of the Vitamins.** By Katharine H. Coward, D.Sc. (Head of Nutrition Department, Pharmaceutical Society of Great Britain). Published by Baillière, Tindall & Co., London. Price 12/6.]

We all look forward to the day when every vitamin will have been isolated, its chemical composition determined and its synthesis accomplished. When the pure compounds are readily accessible their chemical, physical and biological properties can be investigated under carefully defined conditions and highly specific chemical and physical tests may be devised not only for the detection of the presence of vitamins in foodstuffs but also for their accurate estimation. Until such rigid methods are available it will be necessary to continue to assay vitamins by biological methods.

Where biological methods are employed it is essential to take special precautions to avoid drawing wrong conclusions from results of work carried out on too few animals. Reasonably large numbers of animals are always necessary so that individual variation can be given no more than its proper significance. In the assay of vitamins by biological methods it must be remembered that the response to a given dose of a vitamin fluctuates from time to time, a result probably depending upon the vitamin reserves of the animal at the time. This fact makes it essential that "*each* test must be a comparison between the response given to a dose of the test substance and the response given to a dose of the standard *at the same time*. In every test, half the animals available should be given a dose (or doses) of the test substance and the other half should be given a dose (or doses) of the International standard." Since the response of animals to a dose of standard varies as much as the response to a dose of vitamin in any other form equal numbers of animals must be used for the standard and for the test substance.

As International standards are at present only available for vitamins A, B_1, C and D, the methods of assay of these vitamins alone are given in this book.

Not only has the author described in considerable detail the care required in the breeding and keeping of the necessary animals, the apparatus required for the methods used and the several biological methods available for the assay of these vitamins but she has also given at reasonable length an account of the statistical methods used, the order of variability obtained and the accuracy secured in

the various methods described. A useful chapter is included in the book illustrating the effect of a deficiency or excess of one dietary factor upon the assay of another.

A book of this nature is invaluable to all those engaged in research upon problems of nutrition and it is not without its lessons for investigators in the many problems dealing with the health of animals and, in fact, to clinicians who prescribe vitamin preparations for their patients. The value of the book is enhanced by the fact that Dr. Coward has drawn so extensively upon her own enormous experience of this type of work and that her practical detail is largely restricted to methods of which she has personal knowledge. Much other useful data on vitamins is incorporated in the text. The book will be referred to frequently by all those who are concerned with the quantitative estimation of vitamins in foods, in preparations of the vitamins for therapeutic use and in preparations made during investigations on the vitamins and which have to be examined for biological activity. It will be of considerable interest also to members of the veterinary and medical professions.

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[**Animal Year Book. Vol. V.** Published by University of London Animal Welfare Society at 2/6.]

The fifth volume of the Animal Year Book is, as usual, full of interest to the veterinary surgeon and to animal lovers generally. It embraces a variety of subjects, from viruses and whales to photography. Sir Peter Chalmers Mitchell contributes a 15-page article on Game Preserves and National Parks, a topic to which much publicity has recently been given. The fishing of Antarctic whales is graphically described by Mr. D. John, whilst F. C. Fraser discourses upon the effect of control measures on sealing. The perennial question of tuberculosis control in cattle is discussed by Geoffrey Brook, and there are other illuminating articles upon such diverse matters as control of rabbit population, euthanasia, electrocution, cruelty, and the welfare of animals in a number of foreign countries. There is no doubt that the book affords not only enlightenment but a considerable amount of entertainment, and is well worthy of careful perusal.

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Also received: "Adventures of Stumpy"—as written by Stubby the cat. pp. 158. Illustrations 12. Published at 3/6 by The Mitre Press, E.C.3.

REPORT

[**Central Provinces and Berar.** Report of the Civil Veterinary Department for the year ending March 31st, 1937 (Garewal, J. S.). Govt. Printing, Central Provinces, Nagpur, India. Price Rs. 1.8.0.]

The superior staff consists of a Director of Veterinary Services, one Deputy Director, three (?) Assistant Directors and one Veterinary Investigation Officer with a subordinate establishment of eleven Veterinary Inspectors and 141 Veterinary Assistant Surgeons.

The year was a healthy one and there was a notable fall in the mortality from rinderpest. Special attention has been paid to prophylactic measures against rinderpest, goat virus vaccination being largely adopted.

A special feature of the work of the Central Laboratory, Nagpur, was the preparation of certain biological products, which are being used extensively.

The number of veterinary hospitals was 104, as in the previous year, but to provide more veterinary aid 100 outlying dispensaries were opened during the year. There was a slight fall in the number of cases treated at the dispensaries on tour, which is attributed to the general healthiness of the year.

G. K. W.

AN IRISH FARRIERY

Few entrances can have been designed more emblematically than that which indicates the function of the little building illustrated in the photograph, reproduced herewith, of a forge in Aughrim, Co. Wicklow. Major J. Mullany, forwarding it from Enniscrone, states that the structure (including the nail heads) is of cut stone and is dated 1878.

N.V.M.A. DIVISIONAL REPORT

Midland Counties V.M.A.*

ANNUAL MEETING AT BIRMINGHAM.

The Annual Meeting of the Midland Counties Veterinary Medical Association was held at the Grand Hotel, Birmingham, on Thursday, March 24th. The retiring president, Mr. W. Trigger, occupied the chair, and the other members present were Messrs. R. H. H. Over, S. Jennings, J. A. Cormack, W. L. Dwerryhouse, O. V. Gunning, J. T. Morton, H. Tudor Hughes, L. W. Heelis, F. L. Gooch, H. W. Griffiths, K. D. Downham, A. Mackenzie, J. W. E. Budge, S. M. Woodward, A. A. Forsyth, W. F. Aston, T. B. Yarrow, W. Scott, J. W. Conchie, B. E. Davies, H. E. Powell, A. Fewings, H. W. Steele-Bodger and the Hon. Secretary (Mr. H. W. Dawes).

The visitors included Miss M. L. Bingham, Messrs. N. J. Scorgie, D. Macmasters, P. N. C. Green, J. A. J. Venn, A. Lawton Turner, A. P. Hughes, and P. M. Blackham.

Apologies for absence were received from Sir Frederick Hobday, Sir Gilbert Barling, Dr. Graves, Messrs. L. C. Tipper, J. Martin, E. Ringer, P. O. Bayliss, T. Spencer, M. Sadler, T. H. Hughes, G. E. Hutchinson, T. J. Brain, J. L. Brain, B. Secker, C. M. Peatt, G. F. Banham, K. A. Miles, D. Forwell, H. Burrows, C. Haywood, T. Hobson, A. Renfrew, W. L. Dartnell, C. F. Parsons, W. F. McConnell, and E. O'Neill.

Nominations for Membership. — Nominations for membership of the Association were received as follows:—Mr. E. R. Greenwood, Leicestershire County Council, proposed by the Hon. Secretary on behalf of Mr. P. Crosfield; Mr. P. N. C. Green, of Leamington, proposed by the Hon. Secretary on behalf of Mr. John Scott; Mr. J. Drummond, of Tutbury, proposed by Mr. O. V. Gunning; and Mr. Duncan Macmasters, of Knowle, proposed by Mr. S. Jennings.

Resignation. — A letter was read from Mr. H. J. Burrows, of Derby, asking to be allowed to resign his membership because he found it difficult to attend the meetings regularly. On the suggestion of the president, the matter was held over in the hope that Mr. Burrows may be induced to reconsider his decision.

Royal Sanitary Institute.—The Hon. Secretary read a letter from the Royal Sanitary Institute inviting the Association to appoint delegates to attend the annual conference, which is to be held this year at Portsmouth, from July 11th to 16th. It was resolved to postpone the matter until the next quarterly meeting.

*Received for publication May 2nd, 1938.

TREASURER'S STATEMENT

A communication was read from the hon. treasurer, Mr. W. H. Brooke, regretting that he was not able to attend the meeting that day. He had already circulated a copy of the balance sheet, but it had not yet been audited. This showed that the Association had a satisfactory sum in hand.

Mr. Brooke asked to be relieved of the treasureship, which he had held for many years, partly because he no longer lived in the Midlands, and partly because the state of his health made his attendance at the meetings uncertain.

The PRESIDENT said he was afraid that, in the circumstances, they had no option but to accept Mr. Brooke's resignation as treasurer, which they would do with very much regret. The matter had already been discussed by the Council, which would make a recommendation in due course. In the meantime, the accounts would have to be held over until they had been audited.

This was agreed to.

ELECTION OF OFFICERS

Acting upon a recommendation of the Council, which met earlier in the day, Mr. Howard Dawes, the Hon. Secretary, was unanimously elected president of the Association for the ensuing year.

Mr. A. A. Forsyth kindly undertook to relieve him of the secretarial duties while he was in the chair, and Mr. Forsyth, who has latterly been acting as assistant treasurer, was now appointed treasurer in succession to Mr. W. H. Brooke.

Mr. Brooke's resignation of the office was accepted with very much regret, and a resolution was passed ordering an appreciation of his long services to be entered upon the minutes. It was further resolved that Mr. Brooke be elected an honorary associate of the Association, and that he be made a presentation.

Mr. O. V. Gunning was elected vice-president for the ensuing year, the other vice-president being the retiring present, Mr. Trigger.

Mr. S. M. Woodward and Mr. H. W. Griffiths were re-elected auditors, and Messrs. Yarrow, Cormack and Aston were elected to fill vacancies on the Council.

To represent the Association on the Council of the National Veterinary Association, Messrs. Griffiths, Tudor Hughes, Over, De Vine and Dawes were re-elected.

Next Place of Meeting.—On the recommendation of the Council, it was agreed that the date and place of the next quarterly meeting

be at the convenience of the incoming President, and that a series of practical demonstrations, by members if possible, be arranged.

Vote of Thanks.—Mr. Tudor Hughes moved that the best thanks of the Association be given to Mr. Trigger for his excellent services as President during the year. The duties of the President became more onerous every year and Mr. Trigger had worthily maintained the dignity of the office.

A resolution to this effect was carried with acclamation.

Paper.—The President then called upon Mr. N. J. Scorgie, M.A., B.Sc., M.R.C.V.S., of the Royal Veterinary College, London, to address the meeting on "The Rôle of Vitamins in Animal Nutrition." This address, which Mr. Scorgie termed "a brief survey" of the subject, was heard with much interest, and promoted a useful discussion, opened by Mr. K. D. Downham. [Mr. Scorgie's address is reproduced, together with a report of the discussion and of his reply thereto, at the commencement of this issue.—*Editor.*]

The meeting concluded with tributes of appreciation to Mr. Scorgie for his contribution and to the President for his conduct of the proceedings.

H. W. Dawes, *Hon. Secretary.*

PROTECTION OF BIRDS

In the annual report of the Royal Society for the Protection of Birds it is noted that in 1937 the question of birds acting as germ carriers was again raised. The starling was alleged to be the transporter of foot-and-mouth disease. The same problem confronted all concerned in 1922, and the correspondence which then took place between the Society and the Ministry of Agriculture led to nothing definite being established with regard to any birds being disease carriers. A letter from the Secretary of the Society was sent to the Press in November last asking for definite evidence that starlings and other birds were responsible and quoting a statement made by Mr. Elliot in 1932, when he was Minister of Agriculture, that it had never been established that the disease was spread through birds.

The report shows that last year 60 enrolled watchers furnished reports dealing with the wild birds in their respective areas. There are flourishing colonies of terns at Dungeness, and Brean Down, Somerset, is still a stronghold for raven and peregrine. Thirty years ago hardly anyone visited Brean; to-day there are hundreds of visitors, and were it not for the vigilance of the resident watcher the Down would be ruined as a nature reserve.

During the year the Watchers' Committee dealt with such matters as the establishment and maintenance of bird reserves; the erection and maintenance of bird rests at six lighthouses; endeavours to discover and promote remedies for the suffering and loss of bird life entailed by the pollution of the sea by oil; and the acquiring and recording of information on legislative measures, in force or in contemplation, which affect bird life in the British Isles and abroad.

Notes and News

The Editor will be glad to receive items of professional interest for inclusion in these columns.

Diary of Events

June 30th.—Summer Meeting of the South-Eastern Division, N.V.M.A., at Beckenham, 2.30 p.m.

June 30th & July 1st.—R.C.V.S. written examinations.

July 4th.—Meeting of the Editorial Committee, N.V.M.A., at 36, Gordon Square, W.C.1, 4 p.m.

July 11th & 12th.—N.V.M.A. Council and Committee Meetings, Royal (Dick) Veterinary College, Edinburgh.

Sept. 5th-9th.—Annual Congress, N.V.M.A., at Glasgow.

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Tuberculosis (Attested Herds) Scheme, 1938

Under the powers conferred upon him by Section 20 of the Agriculture Act, 1937, the Minister of Agriculture and Fisheries has approved the Tuberculosis (Attested Herds) Scheme, 1938, incorporating with certain modifications the existing schemes in operation in England and Wales, and Scotland, respectively, and extending their scope to herds other than those of registered milk producers (which alone are eligible under the existing schemes). The new scheme which comes into operation on July 1st continues the present rate of bonus, namely, 1d. per gallon on the milk sold from an attested herd under the provisions of a milk marketing scheme; extends the bonus to milk used for the manufacture on the farm of cheese the sale of which is approved for bonus by a Milk Marketing Board under any scheme or agreement they may have with farm-house cheesemakers; and provides, as an alternative to milk bonus, a bonus on the cattle in the herd at the rate of 10s. per head at half-yearly intervals subject to a maximum of six half-yearly payments. The owners of an "attested herd" may elect to receive either the milk bonus or head-rate bonus.

Details of the scheme and forms of application may be obtained from the Secretary, Ministry of Agriculture, 7, Whitehall Place, London, S.W.1, or from the Secretary, Ministry of Agriculture, Animal Health Division, 15, Moray Place, Edinburgh, 3.

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PERSONAL

Birth.—To Helen, wife of A. P. Steele, of 3, Dundas Crescent, Kirkwall, on June 13th—a daughter.

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ARMY VETERINARY SERVICE

Major W. St. J. F. Macartney is at present in this country on leave ex-India.

R.A.V.C. ANNUAL DINNER, 1938

The following is a list of officers who attended the above dinner on Friday, June 10th, 1938, at Grosvenor House, Park Lane, W.1.:—

Brigadier C. A. Murray, Director, Army Veterinary Services, presided, while Lieut.-Colonel Sir Reginald S. May, K.C.B., K.B.E., C.M.G., D.S.O., Quartermaster-General to the Forces, was the guest of the evening; Major-Generals W. S. Anthony, C.B., C.M.G., Sir Layton J. Blenkinsop, K.C.B., D.S.O., and J. J. B. Tapley, C.B., D.S.O.; Brigadier H. S. Mosley, D.S.O.; Colonels H. E. Gibbs, D.S.O., A. G. Todd, C.B.E., D.S.O., G. K. Walker, C.I.E., O.B.E., F.R.C.V.S., W. H. Walker, D.S.O., O.B.E.; Lieut.-Colonels E. B. Bartlett, O.B.E., A. E. Clarke, G. Conder, D.S.O., O. S. Fisher, O.B.E., H. Gamble, O.B.E., F.R.C.V.S., H. Greenfield, O.B.E., J. J. Griffith, D.S.O., L.A.H., L.R.C.S., F.R.C.V.S., R. W. Mellard, D.S.O., W. N. Rowston, T. Sealy-Green, S. L. Slocock, M.C., F.R.C.V.S., J. J. M. Soutar, O.B.E., F. C. Stratton, G. E. Tillyard, O.B.E., E. G. Turner, D.S.O., L. M. Verney, D.S.O., F.R.C.V.S.; Majors F. J. Andrews, B.Sc., R. M. Bamford, O.B.E., J. Bell, H. Bone, M.C., E. C. Bowes, A. C. Duncan, J. J. Dunlop, M.C., D. A. Gillmor, F. W. Goodall, J. Harrison, C. W. Heane, T. Hicks, Sir Frederick T. G. Hobday, C.M.G., F.R.C.V.S., F.R.S.E., H. J. Hughes, M.B.E., C. H. Hylton-Jolliffe, F.R.C.V.S., M. J. Killelea, R. H. Knowles, C. J. R. Lawrence, O.B.E., J. Leigh, T. Lishman, G. Lloyd, D.S.O., F.R.C.V.S., D. MacDonald, O.B.E., H. Mason, O.B.E., J. J. Mills, J. Mullany, G. E. Oxspring, O.B.E., F.R.C.V.S., E. S. W. Peatt, O.B.E., F.R.C.V.S., J. J. Plunkett, O.B.E., L. H. B. Poer, M.C., F. R. Roche-Kelly, W. M. Rouse, W. L. Sinton, J. Smith, R. T. Smith, G. F. Steevenson, J. R. Steevenson, D.S.O., L. R. Swifte, C. H. S. Townsend, O.B.E., M.C., F.R.C.V.S., R. Tindle, E. Wallace, G. F. Watkins, G. Williamson, O.B.E., T. E. Campey, M.B.E.; Captains E. Brayley-Reynolds, O.B.E., J. T. Edwards, J. Going, G. F. Ives, A. A. Kidd, W. P. Moss, A. D. Seton, R. Simpson, F.R.C.V.S., A. J. Warburton; Lieutenants T. A. R. Chipperfield, B.Sc., W. E. Turton.

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DIPLOMA IN VETERINARY STATE MEDICINE

On the results of the examination held by the Royal College of Veterinary Surgeons in London, from June 13th to 16th, the following candidates have been awarded the Diploma in Veterinary State Medicine:—

Mr. W. M. Brownlie, B.Sc., M.R.C.V.S., Mr. W. Castles, M.R.C.V.S., Mr. R. Ford, B.Sc., M.R.C.V.S., Mr. K. C. Sellers, M.R.C.V.S., Mr. A. Shenton, M.R.C.V.S., Mr. J. F. C. Swan, M.R.C.V.S.

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THE INTERNATIONAL HORSE SHOW AT OLYMPIA

Children, whose ages ranged from 12 to 16, have provided one of the spectacular features of the International Horse Show, held at Olympia from June 16th to 25th.

They were members of the Wiltshire branches of the Pony Club and they presented a pageant of "Riding and driving in Regency days" and, incidentally displayed how the equestrian art is being maintained in the days of George VI.

The Metropolitan Mounted Police and Traffic Patrols made a welcome return to Olympia in their combined horse and motor cycle display. Those who saw their demonstration of horsemanship and control of motor vehicles two years ago will remember the thrill of their performance. Their movements carried out during the past week appeared to be even more intricate than in their former appearance at Olympia. Thirteen officers of the mounted branch and twelve officers of the traffic patrols took part.

With horses at a rapid canter and motor cycles roaring at their heels, the demonstration went on in a series of ever-changing movements. Traffic controls dashed under the horses' noses, swept round their tails; horses and cycles passed each other singly and in groups; and evolved various patterns. Pole jumps looped to bicycles a few yards apart were jumped by the horses, and Sergeant King, with Quiz, cleared a difficult jump formed by crossed lances. The display demonstrated the high standard of training of the horses, the majority of which are remounts which have been less than 18 months in the force, and also showed the skill attained by the traffic patrols.

The Spahis, with a flourish of trumpets, gave a remarkable display of horsemanship. The detachment of the 6th Algerian Spahis, the regiment which has received orders to escort the King when he visits Paris on June 28th, consists of 24 trumpeters with drum horse and a French officer and 24 men. They made a picturesque entry in their distinctive Arab cloaks and mounted on small white horses. Riding at the gallop they demonstrated their skill with the sabre and at musketry.

Expert equitation, which is coming back to favour and is making yearly progress, receives great encouragement from the annual international dressage competition. For the first time the official tests took place in this country, and proved an attractive feature of the show. They were held under the patronage and direction of the Fédération Equestre Internationale. Judging took place in the three tests which constitute the competition.

Continental horsemen have specialised in this form of equestrian art to a much greater extent than horsemen in this country, and hitherto Great Britain has not been represented in the international tests. The holding of the competition in London has provided an opportunity to British officers to take part in the tests, and it is gratifying that in the initial test, that of the Prix Caprilli, a British officer, Captain R. B. Sheppard, of the Equitation School, Weedon, with Smarten, a six-year-old bay mare, provided the best performance.

The countries represented in the dressage competition were Great Britain, France, Germany, Holland, Denmark and Czechoslovakia.

The Queen, with Princess Elizabeth and Princess Margaret, visited the Show on Tuesday afternoon (June 21st) and spent nearly three hours watching the judging and the displays of a special gala programme which concluded with the officers' jumping competition for the King George V Gold Challenge Trophy.

After a fine exhibition of jumping, the trophy was won by Major J. C. Friedberger, Royal Horse Artillery, with Derek, an aged brown gelding. The runner-up was Captain X. Bizard, of France, with Gobe Mouche, a ten-year-old chestnut gelding. In 1934 the trophy was won outright by Lieutenant J. A. Talbot-Ponsonby, who represented it for competition. In 1935 and 1936 it was won by officers of the Irish Free State, and last year the winner was Captain Bizard, with Honduras. Captain Bizard made a fine effort to retain the trophy but was beaten in the jump-off.

In the Exhibition section there was on view a display by the Gray Horse Shoe Pad, Co., Ltd., who were showing a new detachable horse shoe pad in addition to their other ranges of "Gragrip" pads.

VITAMIN K

"When chicks are fed on a diet deficient in certain fat-soluble compounds but adequate in respect to vitamins A, B_1, B_2, C and D, and in total fat and cholesterol, they develop internal, subcutaneous and intramuscular haemorrhages," states a recent *British Medical Journal* annotation. "This bleeding is associated with and apparently due to a fall in the amount of prothrombin in the blood. It can be cured by administering a substance found in the unsaponifiable non-sterol fraction of hog liver fat and in alfalfa. This substance is named provisionally vitamin K by Dam and his co-workers.[1, 2, 3, 4, 5] Dogs which have a biliary fistula suffer from a shortage of prothrombin. Since bile acids are necessary for the absorption of fats and sterols from the intestine, it may be that this shortage of prothrombin is due to the non-absorption of the fat-soluble compound, vitamin K. This factor cannot, however, counteract the haemorrhagic tendency in animals fed on spoiled sweet clover hay, which Roderick[6, 7] and Quick[8, 9] have shown to be apparently dependent on a deficiency of prothrombin. Vitamin K is found in hog liver oil, cabbage, spinach, tomatoes and alfalfa. It is not found in cod liver oil or in wheat germ oil. It is not easily prepared from these substances in a state of sufficient concentration for therapeutic use, but fish meal freed from fatty material by extraction with ether and allowed to putrefy forms a good source of this factor, which can be extracted from it by petroleum ether. The yield of oily extract is about 1 c.cm. per lb. of fish meal. The activity of the product was demonstrable on chicks when quantities of 10 mg. were added to each kilogramme of food. Almquist[10, 11, 12] prepared a crystalline distilled product with protective activity when given as 2 to 4 mg. per kilogramme of food. The material contained no nitrogen, phosphorus or sulphur. Its molecule contained an aromatic nucleus but not a sterol ring. Almquist found it to be alkalilabile but fairly heat-stable. Apparently it is optically inactive and has a molecular weight of about 600. Ultra-violet light and absorption material such as aluminium oxide and magnesium oxide destroy its activity. The determination of vitamin K in foodstuffs must be made biologically. Chicks are fed on a vitamin K-deficient diet for three weeks. Blood samples are taken and the plasma is diluted with Ringer's solution and caused to coagulate by adding enough of a clotting agent to make the clotting time normal. The substance whose potency is to be determined is then given to the chicks for several days and blood samples are again tested for clotting time. Clinical trials have been made of preparations of vitamin K whose potency had been determined by experiments on chicks. The doses used by Butt, Snell, and Osterberg[13] were 200 mg. of a preparation of which 23 mg. should be sufficient for a human adult as judged by a comparison of body-weights and food intake of human adults and chicks. Human bile or doses of bile salts (1,000 to 4,000 mg. of "bilron Lilly") were given with the vitamin K extract, the bile being given (in pineapple juice) by mouth or through a tube directly into the stomach or duodenum. Eighteen patients who had obstructive jaundice have been so treated, several as a prophylactic measure. Where the prothrombin time was already high a rapid decrease was obtained by the treatment. Vitamin K given alone to a patient who was not taking food by the mouth was ineffective, but when bile and vitamin K were given together there was a fall in the prothrombin time within 24 hours. Bile alone has frequently been effective in controlling bleeding in jaundiced patients who still eat normally. It is concluded that a normal diet contains vitamin K; or this factor may be formed by the action of putrefactive intestinal flora on the food. By the aid of the bile the vitamin K is absorbed. There is, however, no information yet as to how the vitamin affects the prothrombin content of the blood or the activity of the prothrombin in the phenomenon of clotting."

(1) *Nature*, 1934, **133**, 909.
(2) *Ibid*, **135**, 652.
(3) *Biochem. J.*, 1935, **29**, 1273.
(4) *Ibid.*, 1937, **31**, 22.
(5) *Ibid.*, 1936, **30**, 1075.
(6) *J. Amer. vet. med. Ass.*, 1929, **74**, 314.
(7) *Amer. J. Physiol.*, 1931, **96**, 413.
(8) *Amer. J. med. Sci.*, 1935, **190**, 501.
(9) *Amer. J. Physiol.*, 1937, **118**, 260.
(10) *Pltr. Sci.*, 1937, **16**, 166.
(11) *J. biol. Chem.*, 1937, **120**, 635.
(12) *Ibid.*, 1935, **111**, 105.
(13) *Proc. Mayo Clin.*, 1938, **13**, 74.

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HORSE BREEDING IN ULSTER

The prospects of the horse breeding industry have, in recent years, been the subject of much pessimistic speculation, says the Ulster Ministry of Agriculture. The mechanisation of transport has made such rapid progress that those who prophesy that the day of the horse is nearing an end have not much difficulty in finding arguments to support their views; and even among those who do not take quite such a gloomy view there are many of the opinion that the horse breeding industry is likely to prove a rather unprofitable field of enterprise in the future.

Statistical information in the Ministry's possession goes far, however, to discount these gloomy prophecies as to the prospects of horse breeding. A marked growth in the demand for horses, particularly heavy horses and horses of useful saddle type, has taken place within the last few years at satisfactory prices. The demand for first class horses has been particularly brisk, and present indications are that a stage has been reached when the demand for these horses is keeping pace with the supply. The number of licensed stallions in Northern Ireland, in 1937, was well above the average number for the preceding ten years. The figures for 1938 include, for the first time, stallions between two and three years old, in consequence of the Horse Breeding Act, 1937, which extends the Ministry's licensing scheme, to all stallions of two years old and upwards, instead of three years old and upwards as was formerly the case. The numbers of stallions licensed in the years 1934 to 1938 (inclusive) were as follows:—

	Clydesdale	Thoroughbred	Others	Total
1934 ...	88	35	63	186
1935 ...	94	33	67	194
1936 ...	106	30	65	201
1937 ...	130	27	81	238
1938 ...	146	24	88	258

Even if the 25 Clydesdale and five stallions of other breeds between two and three years old be excluded from the 1938 returns, there would still be an increase over any of the three years prior to 1937.—"N." in the *Scottish Farmer*.

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FOOD OF THE PARTRIDGE

Walter E. Collinge, of the Yorkshire Museum, York, writing in *Nature* (May 7th, p. 834), recalls that just a quarter of a century ago he concluded an investigation on the food and feeding habits of the partridge, and that his results were set

forth in the *Journal of the Land Agents' Society* (June, 1917), and in further detail in *Science Progress* (October, 1918). Collinge found an examination of crop, intestine and stomach contents, over a period of five years to "show that of the total bulk of food consumed 59·5 per cent. is vegetable matter and 40·5 per cent. animal matter. Of the former 53·5 per cent. consists of leaves, fruits and seeds of weeds, 3·5 per cent. of grain, and 2·5 per cent. of miscellaneous vegetable matter. Of the animal matter, 23 per cent. consists of injurious insects, 3 per cent. of beneficial species, 4 per cent. of neutral species, 6·5 per cent. of earthworms, and 4 per cent. of slugs complete the summary."

Continuing, Collinge refers to an interesting paper published in the *Journal of Animal Ecology*, in November last, by Mr. A. D. Middleton and Miss H. Chitty. In this paper these authors state: "Perhaps the most striking are the large quantities of green food eaten during the winter and spring months and the very low percentage of animal food. For some reason, partly due to the publications of Collinge, insects have for a long time been regarded as an important and even essential part of the food of partridges." Collinge considers that Mr. Middleton and Miss Chitty have failed to realise one of the most important results of their work, namely, that since he carried out his investigation on the nature of the food of the partridge, in 1912 and 1913, this bird has changed its food habits, just as the rook and the starling have in that period. Like those authors, Collinge chronicled exactly what he found in the stomach and intestines, they in the crops, and the two records show conclusively the change that has taken place. There can be little doubt that this change has not been beneficial to the partridge as a species, for, for some years past, the mortality due to strongylosis and coccidiosis and other causes has been enormous.

Concluding, Collinge states that it is clear to him that here we have a very striking case of reduced vitality due to a change in diet, and it shows how important it is, as he has previously advocated, that from time to time all such investigations should be repeated, in order that the true economic status of any particular species of wild bird should be ascertained.

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SALE OF DRUGS: PHARMACEUTICAL SOCIETY'S INQUIRY

The Council of the Pharmaceutical Society have set up a committee of inquiry to consider ways and means of dealing with problems with which pharmacists are faced.

It would appear from a manifesto circulated by seven members of the Council, including three past Presidents, on the occasion of the ninety-eighth annual election of the Society's Council, that the most difficult problem is the increase in the number of shops at which drugs are sold. The manifesto states that "the number of patent medicine licences alone is evidence that there are more than 140,000 general shops in this country where the sale of medicines is definitely claimed to be one of the purposes for which the shops are kept open. The number of sellers far exceeds the number of licensees."

All sections of the drug business, including the chain store companies, are represented on the committee of inquiry. The number of chemists' shops in this country is approximately 15,000. This total includes the shops owned by the big companies, each one of which is managed by a member of the Pharmaceutical Society. The memorandum implies that competition from general shopkeepers is eating into the business of individual chemists and chain store companies alike, and further that the uncontrolled sale of medicines constitutes a public danger. At present there is no restriction on the sale of drugs, except those which are scheduled poisons; and the medicinal preparations containing poisons are comparatively few.

Largely as a consequence of the encroachment on what the memorandum describes as the pharmacists' "proper domain" and partly because of higher educational requirements now exacted, there has been a decline in the number of pharmaceutical students in the past two years.

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PROTECTION OF THE FAUNA AND FLORA OF AFRICA

The Second International Conference for the Protection of the Fauna and Flora of Africa, which has been called to review the working of the convention signed at the first conference in 1933, was held recently in the Moses Room at the House of Lords. Delegates attended on behalf of the Governments of the United Kingdom, the Union of South Africa, Southern Rhodesia, France, Belgium, the Netherlands, Egypt, Anglo-Egyptian Sudan, Portugal, and Italy.

Lord Dufferin and Ava, Under Secretary of State for the Colonies, in opening the conference, said the convention of 1933 might be described as the Magna Carta of wild life preservation not only in Africa, for which its provisions were primarily intended, but also elsewhere. The principles laid down in the convention formed a solid and impressive structure on which wild life preservation measures should be modelled.

Lord Onslow, who presided, said the British Government considered that a further conference might be called to discuss tropical Asia, possibly next year, to which the interchange of views in the present conference would be preparatory.

Mr. C. T. te Water, High Commissioner for the Union of South Africa, said his Government proposed to continue its policy of providing game reserves and national parks. Since the opening of the Kruger National Park preservation of wild life had become a matter of national pride with the people of the Union, which in many respects was ahead of the convention. Both the Federal and Provincial Governments were highly interested, and the latest development was the purchase of land for the preservation of herds of mountain zebra in the Oudtshoorn district.

The Belgian delegation, headed by the Ambassador, in reporting on the application of the convention to the national parks and game reserves in the Belgian Congo, gave a list of the decrees on the control of hunting and fishing incorporated in the legislation for that Colony.

The British report, submitted by Sir William Gowers, Senior Crown Agent, detailed the national parks and game reserves begun or in prospect in various British Colonies. Among them were the 4,000 square miles of national park established by the Tanganyika Government on the Serengeti plains. The Government of Nyasaland were investigating the creation of national parks in certain existing forest or game reserves, and the conversion of the Tangadzi Stream Game Reserve in the Lower Shire District into a strict natural reserve. Other possible developments were: National parks in northern provinces of Nigeria, where areas are being

investigated; two forest reserves of 206 square miles for game reserves in Sierra Leone; a national park in Kenya, where a local committee has begun discussions; and the setting up of a game department in Northern Rhodesia and the possible creation of a national park there.

Mr. B. F. Wright, Acting High Commissioner for Southern Rhodesia, said the following game reserves were already in operation: Victoria Falls Game Reserve, 210 square miles; Wankie Game Reserve, 5,142 square miles; and Kazuma Pan Reserve, 76 square miles. In addition Lake Alice in the Bubi district, five square miles in extent, had recently been declared a bird and game sanctuary. Another area of 2,250,000 million acres in the south-eastern part of the Colony was under consideration for definition as a game reserve.

M. Rady, for the Egyptian Government, explained that the latter was thinking of establishing a national park in that country.

Signor Casardi announced that the Italian Government had established national parks at Semien, on the Gillalo Range, and in Lower Jubaland, and a strict natural reserve at Bubasci, and proposed to establish reserves in the Forest of Nassango and elsewhere. A scientific mission now exploring East Africa was surveying other possible sites.

At a later session a discussion took place on the question of modifying the terms of Article 10 of the Convention of 1933 by the introduction of a definition of animals which might be regarded as vermin, and which might, therefore, be destroyed by any method of hunting, including those referred to in paragraph 2 of the Article. On the proposal of Mr. te Water (Union of South Africa) the conference agreed to invite Governments to submit observations on this question for consideration before the opening of the further conference to be held in a year's time.

Centralised Information

The conference considered the question of the exchange between Governments of lists of persons known to have been guilty of persistent infringements of game regulations, and also the question of the exchange of information relating to infectious or contagious diseases of importance in the preservation of fauna or flora, or capable of affecting men as well as animals. A discussion took place on these questions in which Mr. E. B. Bowyer (United Kingdom), Dr. van Straelen (Belgium), and Mr. te Water (Union of South Africa) addressed the conference, and Mr. Hemming (Secretary-General of the conference) described the system which had been instituted for the centralisation of information furnished by a large number of Governments on the movements of locusts, which enabled early warning to be obtained of the possibility of locust outbreaks. The conference took note of this system and were agreed in regarding it as a valuable example of the methods by which a satisfactory exchange of information on technical questions of this kind might be organised.

The conference agreed that the next meeting should take place in conjunction with the conference which it was hoped to assemble in a year's time to deal with the question of the protection of the fauna and flora of Africa, Tropical Asia, and the countries of the Western Pacific.

The international convention of 1933 for the protection of the fauna and flora of Africa has now been ratified by all the ten Powers by which it was first elaborated.

SALT AS A THERAPEUTIC AGENT

In view of the persistent advocacy of our colleague, Mr. W. W. Lang, of the virtues of salt treatment for a variety of the commoner internal ailments of horses, the following annotation from a recent issue of the *Lancet* is perhaps significant. It occurs to us that in the West Coast of Africa work has been done recently (by Henderson and others) indicating the great importance of salt deficiency in cattle, and it is not unlikely that in a less aggravated form a similar deficiency state may be more prevalent than has been recognised hitherto. The subject of sodium deficiency needs now to be well explored and reviewed.

"How many medical men, asked to select the ten most valuable drugs, would include common salt on their list? And yet it has an undoubted claim; indeed few would omit it once they had thought of it in this connection. Of its many uses we may here mention two, one of which is new. In the United States, Sandstead and Beams* claim that administration of sodium chloride in large doses (0·25 to 0·5 g. per kg. body-weight per day) leads to complete or almost complete relief of the pain of diabetic neuritis and to improvement in the peripheral circulation of elderly diabetics. If this claim should be substantiated, the physician with diabetics under his care will be provided with a much-needed remedy. In India, Chakravarti and Tyagi,† under the title of 'studies in effects of heat,' describe ten cases of collapse during the hot weather at Allahabad. In all ten there were signs of severe salt deficiency and its attendant renal complications, and it is clear that these patients would probably not have collapsed if they had been taking enough salt with their food. These are glaring examples of serious deficiency disease. It is axiomatic that for one example of a frank deficiency disease there must be hundreds of other masked and subacute forms in the same district. The observations of Chakravarti and Tyagi, therefore, support the view already expressed in our columns,‡ that mild degrees of salt deficiency must be a common source of chronic ill health in the tropics."

*Sandstead, H. R., and Beams, A. J., *Arch. intern. Med.* March, 1938, p. 371.
†Chakravarti, D. N., and Tyagi, N., *Indian J. med. Res.* January, 1938, p. 791.
‡McEwen, O. R., *Lancet*, 1935, **1**, 1015; McCance, R. A., *Ibid.*, 1936, **1**, 767.

Correspondence

Letters to the Editor should reach the Office not later than by the first post on Tuesday morning for insertion in following Saturday's issue.

All correspondence must bear the name and address of the contributor for publication.

The views expressed in letters addressed to the Editor represent the personal view of the writer only and must not be taken as expressing the opinion or having received the approval of the N.V.M.A.

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THE MINISTRY'S PANELS

To the Editor of the Veterinary Record

Sir,—The above subject has produced a very interesting correspondence which, so far as I am concerned, can be summed up this week in the terms "mercy" and "optimism."

I am informed that it is no good "strafing" the Ministry of Agriculture as their expenditure is regulated by an ill-disposed Treasury; the reply to which is that if nothing is gained by

"strafing" the Ministry, less than nothing is gained by not doing so. My opinion still is that if there were the same driving force behind the Minister of Agriculture as there is behind the Ministry of Health, fees, compensation and conditions of service, would be adequate.

One of the most interesting letters published is that embodying the scheme outlined in your correspondence columns last week: it is broad-minded and reasonable but it demands "optimism." One might criticise on details such as that any part-time officer should be able to deal with tuberculosis met with on his inspections of accredited herds, if such is not intended to be the case. Again, that all markets and sales inspection should be carried out by the part-time officer, leaving the whole-time staff free for the direction of the war on tuberculosis.

As regards hardship, my own case was forwarded, as stated in my previous letter, and the reply received in essence was "to accept Panel 'B' for what it was worth"! (the note of exclamation is my own). I then put forward the suggestions familiar to the readers of your correspondence columns and it was stated that these would be put before the committee, which apparently has not yet met, but as an opportunity arose the matter was brought before the bar of public opinion. I still consider the case should have been brought forward as a matter of sheer injustice.

I understand there is a "good time" coming in about a year's time, but "whilst the grass is growing the steed is starving."

Yours faithfully,

Folkestone. HUGH P. HOGBEN.

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METHODS OF TUBERCULIN TESTING

To the Editor of the Veterinary Record

Sir,—Upon reading Mr. Muir's letter on the above subject in the current issue of the *Veterinary Record*, I feel compelled to enter the discussion upon this apparently contentious subject.

It would appear to me that the advocates of specific forms of the test have each given special study and care to the particular form which they favour and have thereby become more or less expert in its application. By this, I clearly assume that each and all of the tests require some considerable practice and experience before the operator may become efficient in their application.

I am a whole-hearted supporter of the double intradermal test, applied in the region of the neck, and I am honestly of the opinion that the test is 100 per cent. reliable if, and when, observation and investigation have removed or explained the few unusual conditions which occasionally are met with in conducting the test.

As an example, it has occasionally occurred to me, when testing a herd, that a few animals have shown at the site of injection, a circumscribed and indurated swelling as much as half-an-inch in diameter and an increase in the measurement of the double fold of skin to as much as 7 mm. above the initial measurement. I may say that this condition occurred more often before the introduction of synthetic medium tuberculin. I usually treated these cases as "doubtful" and re-tested in one month, when the majority showed "no reaction." I had the opportunity, in many cases, of making a *post-mortem* examination upon the animals at a later date and have never had a case which has refuted my final decision.

Since January 1st last I have taken the greatest care in injecting the dose of tuberculin at three-quarters the depth of the single layer of skin. To do this requires great care and considerable practice, but the results obtained have been most gratifying as all measurements are uniform and when a reaction occurs one has no hesitation in making a decision, except in the very small ones.

I agree with Mr. Muir, that it is the "character" and not the "size" of the swelling by which one's decision should be arrived at.

The double intradermal test requires, without a doubt, considerable practice and experience to be efficient and I often wonder how our teachers can teach the subject with the scant material they have at their disposal. Unclean herds with a large number of reactors, showing varieties of reactions, are absolutely necessary. It is next to useless to demonstrate the test upon a tuberculin tested herd, where no, or at most, two or three reactors only may be found.

I think a great error is made by many in introducing methods to expedite the test at the cost of lessening its efficiency and thus encouraging errors. It should be borne in mind that a decision often means the life or death sentence to an animal and great financial loss or gain to its owner.

My great objection to the "caudal fold test" is that it is unhygienic and when the animal defaecates (which the cow often does during the operation) it becomes a most filthy operation. The claim made by its advocates that only two visits are necessary is, or will be, equally true of the double intradermal test when everyone has taken the trouble to become efficient. I do not experience more than one case in a herd of a hundred bovines of an animal reacting at the seventy-second hour which had not shown a reaction at the forty-eighth hour, or even earlier.

A committee was set up by the N.V.M.A. to consider the subject: it had, I believe, two meetings at both of which the Chairman was of opinion that nothing could be done in the matter and thus the committee became defunct.

I stated four years ago that the double intradermal test would aid the profession to soar to unknown heights or cause it to sink into unfathomable depths. This is as true to-day as then. The task in which we have been invited to assist is the most noble and important ever entrusted to us and I think it behoves every unit of our profession to give of its best, to cease cavilling, and to unite in an honest endeavour to correct any errors that there may be in our technique and thus proceed to the ultimate goal of "success."

Yours faithfully,

J. C. COLEMAN.

Swindon.
June 20th, 1938.

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ROYAL COLLEGE OF VETERINARY SURGEONS

Election of Council, 1938

To the Editor of the Veterinary Record

Sir,—I shall be glad if you will kindly allow me to return my most grateful thanks to those who recorded their votes in my favour at the recent R.C.V.S. Council elections.

Yours faithfully,

J. C. COLEMAN.

Croft Road,
Swindon.
June 18th, 1938.